The Journal
OF THE
Royal United Service Institution.

VOL. XXX. 1886. No. CXXXIII.

SPECIAL LECTURE.

Wednesday, December 16, 1885.

GENERAL SIR C. P. BEAUCHAMP WALKER, K.C.B., Vice-President, in the Chair.

ENGLAND, CHINA, AND RUSSIA IN ASIA.

By ARCHIBALD R. COLQUHOUN, Gold Medallist, F.R.G.S., late Special Correspondent of the *Times*, &c.

IN the storm and stress of the Elections certain items of news which have recently reached us seem to have attracted no attention, although, of great importance to the country, they might have been expected to have exerted a powerful influence upon the minds of the people. It will be useful, therefore, now to draw public attention to certain facts which indicate clearly that there is a question requiring vigilance and resolute treatment at the hands of whatever Government may finally be placed at the helm of State.

The recent banquet given at St. Petersburg in honour of Ignatieff, as originator and signatory of the famous "supplementary" treaty of Peking in 1860; the disorders and dangers along the Russo-Chinese frontier of Kuldja, where the Cossack pickets are unable to prevent the inroads of Chinese soldier-brigands; the recent collisions along the Russo-Chinese frontier in the Amur districts; the Russian intrigues in Corea; the intelligence that Turkoman and Usbek envoys from Northern Afghanistan are imploring Russian protection; the news that Sarakhs and Merv, as well as Askabad, are now fortified positions, and that Penjdeh is already in direct telegraphic communication with Russia;—all these are indications that Russia is silently preparing to make use of her opportunity for again menacing, again striking another blow at, the integrity of India or China, an opportunity which she always finds in the hour of perplexity or extremity of her neighbour.

But where is Russia to find the opportunity? In this. She is aware that with a strong united Government established in England, a cordial understanding with China would be the keystone of our policy in Asia, and with such an understanding she would have to abandon for the time all idea of aggression. But with an irresolute and feeble Government Russia would find her opportunity, and would

seize it, and she would then be able to deal with India and China alternately, as occasion might offer. China is anxious to secure the friendship of, to act in unison with, a strong and united Government in England; but she will expect nothing, have nothing to do with a weak and disunited one. Should such a Government be placed in power, China, which has a fixed and statesmanlike policy as regards Russia, will act independently, and in doing so she would act wisely. She is now engaged, as she has been, indeed, during the past few years, in vigilant preparations, and is prepared to take prompt and bold action, if necessary.

In view of the enormous interests of England, present and future, in that part of the world, and their bearing upon the interests of England, it will be well to sketch briefly the present situation in Eastern Asia.

England's Asiatic dominions and dependencies cover more than 2,500,000 square miles. She has 270,000,000 of souls under her rule, speaking some twenty languages. Her European military strength in Asia is 70,000, with 140,000 native auxiliaries, while her naval force counts some forty vessels. She has 10,000 miles of railway, and 20,000 miles of telegraph on land in Asia, and some 8,000 miles of submarine cable. She has invested in her territories, either in State loans or railways under the State, over 250,000,000*l.*, besides scores of millions sterling invested in private enterprise—agricultural, commercial, industrial—which cannot be exactly estimated. The foreign trade with these territories is over 150,000,000*l.* annually, of which over one-half is with England. The trade of other Asiatic countries with Europe is over 60,000,000*l.*, of which four-fifths is English, while an enormous coasting trade, growing yearly with great strides, is mainly in our hands. The trade between Eastern Asia and our Australian Colonies is growing yearly, and has a great future before it.

The Asiatic dominions or dependencies of Russia are two-and-a-half times as great as our own, containing over 7,000,000 square miles. But they have a population of only some 18,000,000, not one-fifteenth of our Asiatic population, scattered over this enormous region, which in economic wealth is poverty-stricken compared to our own. It is this simple fact more than any other which makes the rapid advance of Russia towards India and China in the present generation so significant. From the shores of the Caspian as her base she has, at enormous sacrifice in life and treasure, thrown forward a network of communications towards Central Asia and Afghanistan. In the Amur she is making great efforts to consolidate herself, and to perfect the communications between Vladivostock and Russian Siberia. She is now in a position to put in practice her policy of exerting pressure upon the Afghan and Chinese frontiers, and thus gain what she wants on the seaboard in the east and west. Her trade with Eastern Asia, consisting almost entirely of tea from China, is trifling.

French interests in Asia consist of her possession of Cochin China, covering an area of 22,000 square miles, with a population of 1,700,000; Camboja 40,000 square miles and a population of 1,000,000; Annam (including Tonquin) 200,000 square miles, with a

ina
the
ent
vith
in
rds
ely.
few
and

ire,
of
in

han
ule,
gth
val
and
of
ate
s of
om-
ign
ver
vith
an
nly
ian

alf
les.
nth
ich
t is
nce
so
nas,
ork
the
fect
She
ure
nts
sia,

hin
ion
of
h a

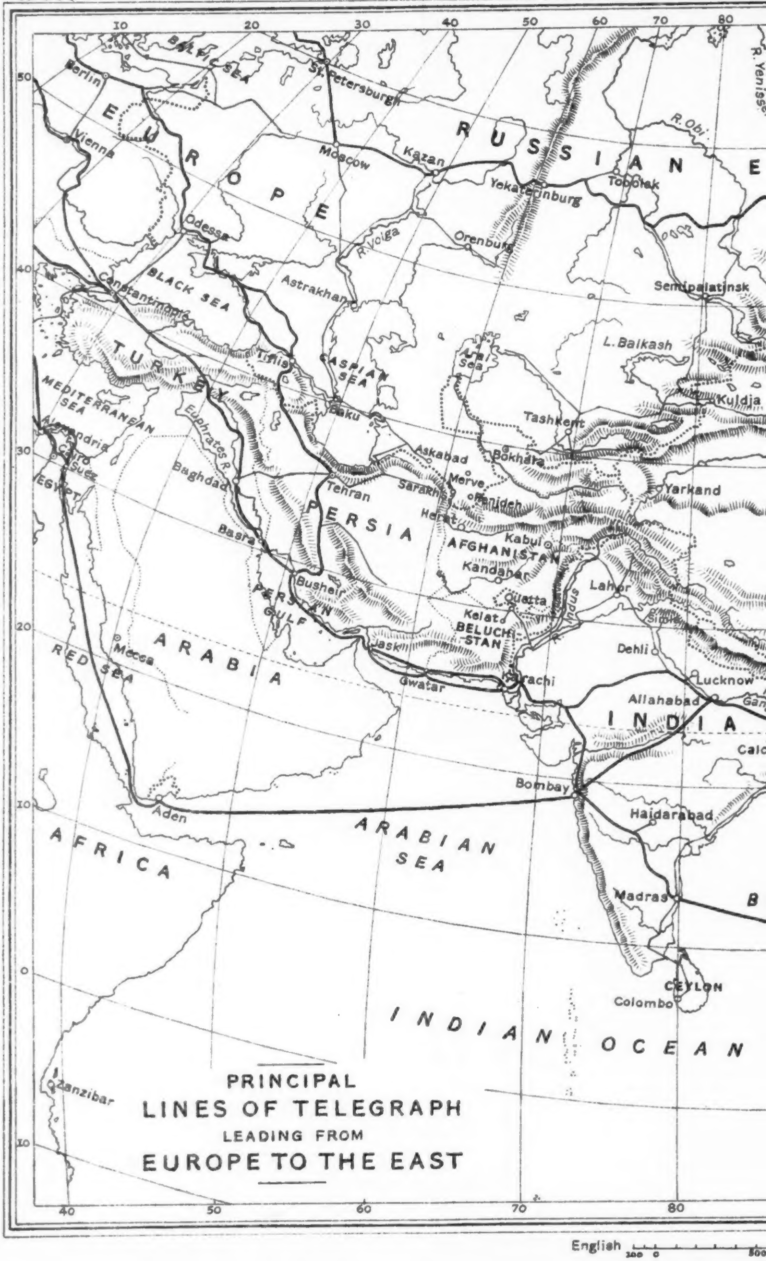
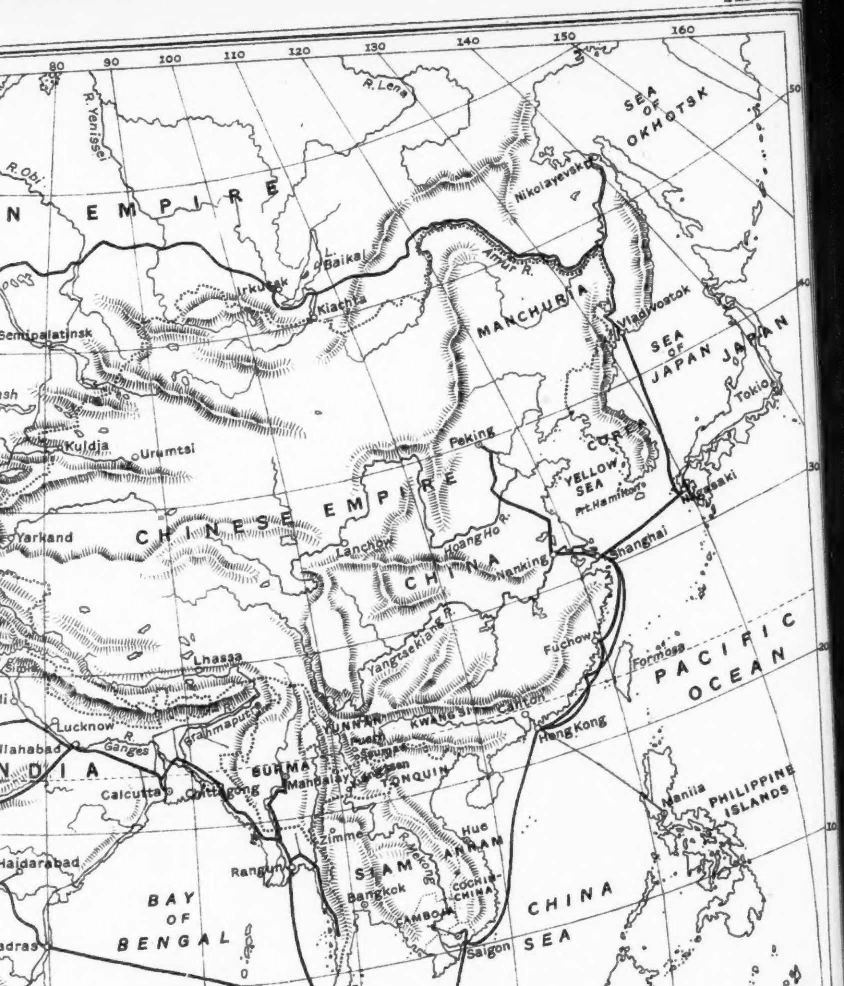

PRINCIPAL
LINES OF TELEGRAPH
LEADING FROM
EUROPE TO THE EAST
EUROPE
RUSSIAN E
BALTIC SEA
Berlin
Vienna
St. Petersburg
Moscow
Kazan
Yekaterinburg
Tobolsk
R. Obi
R. Yenisse
Odessa
R. Volga
Orenburg
Semipalatinsk
Astrakhan
BLACK SEA
Constantinople
TURKEY
Tiflis
CASPIAN SEA
Baku
Aral Sea
L. Balkash
Kuldja
Tashkent
Bokhara
Askabad
Merve
Sarakhs
Penjdeh
Herat
Yarkand
MEDITERRANEAN SEA
Alexandria
Cairo
Suez
EGYPT
Euphrates R.
Baghdad
Tehran
PERSIA
Basra
Kabul
AFGHANISTAN
Kandahar
Quetta
Lahor
Indus R.
Bushehr
PERSIAN GULF
Kelat
BELUCHISTAN
Simla
Dehli
Jask
Gwatar
Karachi
Lucknow
Allahabad
INDIA
ARABIA
Mecca
RED SEA
Bombay
Haidarabad
Aden
ARABIAN SEA
AFRICA
Madras
CEYLON
Colombo
INDIAN OCEAN
Zanzibar
English

Plate I.



EMPIRE
CHINESE EMPIRE
CHINA
INDIA
SEA OF OKHOTSK
SEA OF JAPAN
JAPAN
MANCHURIA
COREA
YELLOW SEA
PACIFIC OCEAN
CHINA SEA
BAY OF BENGAL
OCEAN
PHILIPPINE ISLANDS
BORNEO
CELEBES
SUMATRA
CEYLON
BURMA
SIAM
ANNAM
TONQUIN
YUNNAN
KWANG SI
COCHIN-CHINA
CAMBOJA
MALAY PEN.
R. Lena
R. Yenissei
R. Obi
Amur R.
L. Baikal
Hoang Ho R.
Yangtsekiang R.
Ganges
Brahmaputra
Mekong
Nikolayevsk
Irkutsk
Kiachta
Semipalatinsk
Kuldja
Urumtsi
Yarkand
Lhassa
Lucknow
Allahabad
Calcutta
Chittagong
Mandalay
Rangun
Haidarabad
Madras
Colombo
Penang
Singapore
Batavia
Saigon
Bangkok
Zimme
Hue
Hong Kong
Canton
Fuchow
Formosa
Manila
Shanghai
Nanking
Peking
Lanchow
Nagasaki
Vladivostok
Tokio
Prt. Hamilton
Stanfords Geogr. Establ.
Miles

popul
trade
Ou
merci
powe
maint
the S
Port I
upon
sessio
the p
comm
the d
necess
the su
India
volum
and h
part o
there
time a
positio
mean
to un
advant
loss o
tegrat
The
dicted
France
over a
otherw
France
and it
in mer
disillu
Tonqu
countr
or tra
govern
benefit
China.
for a v
draine
was un
from "
The
which
party
ordina

population of about 10,000,000; in all about 13,000,000. The total trade represents merely some 7,000,000*l.* sterling annually.

Our possessions furnish us with most admirable bases for commercial expansion in Asia, such as are not, and never can be, in the power of any other nation, unless forcibly wrested from us. We maintain along the avenues of our Eastern trade, as strategic points, the Suez Canal, India, Ceylon, Singapore, Hong Kong, and lastly Port Hamilton, the last of our outposts. It cannot be gainsaid that upon the political supremacy of England in the East, upon the possession and defence of India and our Eastern possessions, depends the power to expand our trade, depends the continuance of our commercial prosperity, and, as a *sequitur*, the ability to support the dense and rapidly increasing population of England. It is not necessary here to recapitulate what has been so often advanced upon the subject, as demonstrating beyond doubt the commercial value of India and the Eastern possessions in contributing to the enormous volume of home and intercolonial traffic now possessed by England and her Colonies. To willingly give up these English possessions, or part of them, there is happily now no longer any avowed desire, and there is less indifference to their advantages than there was a short time ago. To lose them would not only involve the loss of invaluable positions for commerce, and of an enormous volume of trade, but would mean also the handing them over to rivals, who are not at all averse to undertake the necessary responsibilities, and thus to reap the advantages to be gained therefrom. In one word, it would mean the loss of the commercial supremacy of England, and the rapid disintegration of the Empire.

The real outcome of the Franco-Chinese War has been, as I predicted, something never dreamt of in the plans of either belligerent. France thought to intimidate China into the surrender of her claims over an immense territory bordering the Empire proper, which would otherwise be an easy conquest for French arms. China has obliged France to make the conquest *de facto*, instead of taking it for granted, and it has been done most imperfectly, and at an enormons sacrifice in men and money, while France has during the process been much disillusioned as to the value of the prize. The country annexed in Tonquin has a rich delta, but is for the most part jungle-covered hill country, most unhealthy, perfectly uninhabitable by French settlers or traders. France will merely have the task of administering the government, with profit or loss, as fortune may determine, for the benefit of natives and strangers, more especially the traders of Southern China. France has gone near to dislocating her whole military system for a worthless object, while the Chinese authorities on their part have drained their treasuries, nominally in defence of a territory because it was under their suzerainty, but in reality to choke off Western nations from "nibbling" at China.

The war has opened a new chapter of international history which it is safe to presume was not in the contemplation of either party to the struggle. What was sure to happen some day in the ordinary course of commercial and colonial development has been

accelerated by the French proceedings in Tonquin and China, and by the movements of Russia—the shifting of the political centre of gravity, the opening of a new and larger Eastern question, and the resumption in the Pacific of the struggle for pre-eminence which was carried on a century ago in the Atlantic. It is inevitable that the question of supremacy in Asia be shortly decided in favour of one or other of the Powers, Russia or Britain. In the coming strife England must in spite of herself play a leading part, since the material interests of the British Empire are by far the heaviest stake in the game. It is even probable that the fate of the Empire itself may be eventually decided in the Eastern Seas. It is therefore a question that concerns all Englishmen in the mother-country and India and the Colonies, and, indeed, all English-speaking people throughout the world, whether English statesmen will rise to the occasion, bringing courage, faith, and intelligence to bear on the direction of affairs, whether they will instruct the people in their true interests and responsibilities, teach them the vital importance of foreign affairs and national defence, or whether, calling upon the people to centre their attention on drastic semi-socialistic "reforms," in a lukewarm, vacillating, and cowardly spirit they will continue as of late years to embroil England and humble her before the nations, and finally cause her to drop out of the rank of Great Powers.

The force which is most constantly, if silently, in motion in this Eastern question, the factor which can always be reckoned on with certainty, is the irrepressible but not unnatural ambition of Russia, which impels her incessantly from the Arctic frosts towards the open sea, a movement which presses on Turkey, on Persia, on India, and on China, in a continuous line of front, extending 7,600 geographical miles right across Asia from the Bosphorus to the Yellow Sea. There is no need to trace here the history of the Russian advance across the barren and thinly populated wastes,—enough to bear in mind that she is now on the frontiers of India and China, the objectives of the movement. Obstacles may retard, but centuries do not change that movement, which is as steady as that of a glacier.

The ambition of France, though continuous in idea, is spasmodic and incoherent in action. Being in an exceptional sense subject to the caprice of constantly changing political parties, who, placing personal rivalries and party jealousies before patriotism, delight in discrediting and reversing each other's policy, and her action being fettered in Europe, it will count for comparatively little in the general struggle. The population of France is receding. Her finances are in a less satisfactory condition than at any other period since 1871. She has no real Colonies. Her military occupation in the East has been a failure, except in Algeria, where she has a base close by in Marseilles. Frenchmen will not go abroad as colonists or private traders. It is therefore safe to predict that France can never hope to colonize in a permanent manner. Still, France may, dangerous as it may prove to her existence as a European Power, elect to play a part in this Eastern struggle, as Gambetta and Skobeleff contemplated, and as under M. Ferry she was inclined to do a short time ago. To France

herself the position she has created in Tonquin is one of grave concern. The last year and a half have changed the situation fundamentally, and though to outward appearance France and China, by the treaty executed last spring, went back to the point at which they stood on 11th May, 1884, when the Li-Fournier Convention was signed, the circumstances are wholly different now. At that time China thought she was under the heel of France, and made her submission without really testing her strength. Had France been able to conserve her prestige she might have consolidated her authority unquestioned in Tonquin, and China would have acquiesced in France's own estimate of herself as an irresistible Power. Or, when challenged to actual combat, if she had dealt a prompt and crushing blow without giving China time to organize resistance, she might still have saved her prestige, and so secured her position in Tonquin without putting her military strength further to the proof. The method actually followed was widely different from this. France has kept up a desultory and exasperating warfare, which, so far from humbling China, has only made her feel her own strength. After the terrible blunder of going to Tonquin with insufficient forces another criminal mistake was made in rooting up all the native machinery of Government, while having nothing to replace it with. Communications, so essential for the pacification of any country, were not laid down. It is now too late to replace the native officials, either killed off or turned into outlaws. The religion of the country was not strictly respected, and it cannot be doubted that the numerous massacres of Christians which have occurred have been due to the unwise policy of trying to enlist the Christian natives as auxiliaries against their brethren. The campaign has, indeed, been neither more nor less than a valuable national training and military education for the Chinese, and, although obliged to stop partly from want of money, but more on account of the threatening attitude of Russia, China is now convinced of her ability in due course to reconquer all her lost territories both on the Amur and in Tonquin. The Tonquin question was forced on the attention of the Chinese people in such a way as to rally their newly awakened patriotism to the support of the Government in its resolution to withstand aggression, and even to recover the temporarily ceded territory, and the 3,000 miles of telegraph now working in China and the extended circulation of the native press has brought into play an agency which has largely helped to rouse this patriotism. China has always shown herself tenacious of an idea. A nation that reckons its chronology by millenniums has staying power, and does not become oblivious in one generation.

It appears, then, that France has placed herself in a highly disadvantageous position in aggressively seizing a territory possessing a frontier line some 300 miles in length, conterminous with an Empire of 300,000,000 people, whom she has converted from shopkeepers and labourers to soldiers, while stirring up in them feelings of patriotism, and hatred towards the French. Tonquin may yet become a millstone around the neck of France, for she cannot abandon the new acquisition without lowering her reputation, and it will be disastrous to attempt to hold it without large forces. A Chinese army of 50,000 to

100,000 men with drill and new arms hanging like an avalanche over the passes of Kwangsi and Yunnan, and a hostile population inside Tonquin, will compel France to spend much money in fortifications and to maintain her military establishments on a large scale for many years to come. It may be conducive to the peace of Europe that France should be thus engaged, but the situation of her Indo-Chinese Empire is one to cause serious reflection to French statesmen.

The pregnant fact emerging out of this imbroglio which most concerns England and the world is the renascence of the national and military spirit in China. Hitherto the Chinese have not considered their army capable of standing before European troops, but they have now proved to themselves and the world in a hard-fought campaign that they can not only make a respectable resistance, but are able to rally their beaten forces and roll back the tide of war. They have now seen the proudest nation in Europe accept from them terms of peace on the morrow of a serious reverse, which Chinese opinion not inexcusably magnifies into a disaster. And it must be borne in mind that the Chinese armies in Tonquin and Formosa were chiefly raw levies taken from the field and placed undrilled in the front, where they learnt whatever they knew of military art. Their "regulars" were always kept in the north ready for Russia, whose diplomacy they understand well from bitter experience. Knowing that Russia never misses her opportunity, and that the only argument she recognizes is force, China kept large bodies of her best troops ready to act in the north. If under such circumstances the Chinese were not elated they would be something less or more than human. The pride which has been flushed by these successes chafed at the sudden cessation of hostilities in the very height of their victory, and the martial ardour of the nation may press for another outlet.

It has often been remarked during the past year, and has been a favourite argument with Frenchmen especially, that if France failed to chastise them, the Chinese would become so arrogant, that within two or three years, some other Power—England always understood—would be forced to take the task in hand. So far as England is concerned, at all events, I say God forbid! It were indeed a lamentable *finale* to a dreary chapter of blundering and bloodshed, were England ever to drift into a conflict with the rising power of China. So plain has the identity of interests between the two Empires become, that to all the better instructed among the Chinese the fear of English aggression is no longer a bugbear, and they are becoming more and more alive to the danger, common to both countries in the constant southward pressure of Russia, which like a threatening cloud broods over the whole northern frontier of China, Afghanistan, Persia, and Armenia. There is probably no internal power in Russia itself to arrest this movement, even were it desired to do so, and so long as she is bringing under subjection inferior races, perhaps there is no objection. Russia claims to be simply obeying a law of sunward and seaward gravitation, and following the course of her national development, which must progress until it encounters the development of other nations stronger and better than

herself. But Russia is not an over-populated country, throwing off its surplus population. She is engaged on a purely military conquest which, after enormous expenditure, has now placed her in an advantageous position for menacing, and perhaps attacking, the two richest and most populous countries in Asia. It seems therefore not unreasonable to believe that she is determined to have seaboard and ports, not for the purpose of patiently building up a commerce of her own, but whence she can threaten and cripple the commerce and power of England and China. Even among that class of politicians who make a virtue of disparaging and belittling their country, few will deny that English civilization, with all its faults, is better than Russian, and more in harmony with the modern spirit. If, therefore, it becomes a question whether Russia or England is to be predominant in Asia, it would be an excess of modesty for England to give way before the absolutely insatiable ambition of the Northern Power. Nor as regards China is there any reason why the world at large should wish to see Russian domination either on the soil of China proper, or her dependencies. The Government of Russia, equally corrupt, is no doubt more vigorous than that of China, and has availed itself more effectively of modern science in its military and industrial services. But the masses of China are in much better case than the masses of Russia, less ignorant, enjoying infinitely greater freedom, and decidedly happier. There is no Bulgaria here crying out, with either a false or a true note, for a Liberator from the North. On the contrary, there is always the passive resistance of the natives to encroachment, a resistance which, with the warlike spirit which has again been infused into this people by their struggle with France, may at any time, if assaulted, assume an active form. The acquisition by Russia in 1860 of the large territory of Manchuria, extending from the Amur River to the Corean frontier, which was filched from China by a trick of Ignatieff's, under cover of the Anglo-French guns, and when China was sorely tried moreover by rebellion, has left a sore which is not yet healed, and which is liable to break out on fitting provocation.

The events of the past two years have, among other important changes in China, caused great development in the political ideas of Chinese statesmen, who begin to comprehend their true position and interest in the world. Hitherto their conception of international relationship might be said to be summed up in the simple alternative of mastery or submission, but the acquaintance with the world which has been forced upon them during their conflict with France has brought them to see that there may be such a thing among nations as fellowship on terms of mutual respect and interest. The visit last spring of an embassy from Japan has given shape and substance to the nascent idea, for by means of full and free explanations between Count Ito and Viceroy Li Hung Chang, their mutual distrust of each other's motives was removed, and a treaty was made regarding Corea based upon a recognition by both countries of the interest which they had in certain common objects. Japanese statesmen have for some time past realized the fact, and in this as in other steps of progress Japan has been in advance of China. Of more value, however, than the treaty was the personal friendship between the two statesmen

which grew out of their intercourse, and the provision made for confidential communications whereby unforeseen occurrences in the future might be prevented from disturbing the good understanding between the two countries.

The fear of encroachment on the part of England, which until a few years ago undoubtedly possessed the minds of the Chinese, has disappeared, and the *rôle* of England in the world is in a measure understood, thanks to the wider grasp which Chinese statesmen now take of international affairs, and to the counsels of their most trusted foreign advisers. Not only so, but the idea of a common interest between the neighbouring Empires, India and China, has been and is being propagated by the native press, rapidly increasing in circulation and influence, thus making a great change in the hitherto exclusive and repellent policy of China, and with the introduction of telegraphic communication through the length and breadth of the country the growth of the idea has been greatly accelerated.

No argument is needed to demonstrate the value of promoting a friendly feeling between the two most populous countries in the world, so widely different in their circumstances, and yet having so many and such vital aims in common. China is learning that the policy of England, whatever it may have been, is now one of commercial expansion and development only, untainted by any ulterior designs, and as China is compelled by circumstances to take a new departure in the direction of industrial and defensive enterprise, she is disposed to look to England as her most efficient guide, and safest ally, in this new path of progress. Better far than "disinterestedness" in international relations is an interest which is mutual, clearly avowed and understood, and such is the bond which cements India and England with China. The advantages which India and England would derive from a close intercourse with China are such as now no longer displease, but entirely commend themselves to the leading statesmen of that country. The opportunity is therefore unique for developing our relations.

To India, the further opening of China and her dependencies offers the advantage of a very considerable expansion of her commerce, and possibly the better supply of labour where most needed, while to England it is a matter of national importance to increase her influence and gain the leadership in the new enterprises, financial, industrial, defensive, which China is obliged shortly to undertake. To promote these objects, increased intercourse and better acquaintance are necessary. Experience in China, as elsewhere, has taught us that one of the chief obstacles to commerce and to international relations—in fact to progress generally—is ignorance of the country and people, and the growth of trade, which has followed the treaties of 1858–60, has been as much due to the liberty of travel therein accorded, and to the better acquaintance thus brought about, as to the access given to new river and coast ports. To China a closer relationship with India (and therefore England) will mean a considerable aid towards the internal reform and consolidation of the Empire, and a pledge of tranquillity throughout the Far East.

If these views are sound, it should be the policy of the Indian and Imperial Government, and of all the neighbouring Colonial Governments, to avail themselves of every opportunity of improving their communications with the vast Empire of China, and by all natural, silent, and unobtrusive means to draw closer the bonds of intimacy, and to establish a friendship on solid and well-defined bases. One of those opportunities is the connection of India with China by telegraph, which, after full consideration of the matter, the Imperial Chinese Telegraph Company, I was assured, is willing to effect. It has been in contemplation for some time to connect the Chinese with the Russian land lines by carrying the wires from Peking to Kiachta, a distance of 1,000 miles through a desert region.

The primary object of this line would be to reduce to one-fifth the cost of the Chinese Government messages to Europe, which have been of a most voluminous character during the past two years. The secondary object would be to bring profit to the Chinese Company by opening up to the trading communities of China an extremely cheap service to Europe. But the Chinese perceive the objections to which such a connection would be exposed in that it would place their communications in the hands of a potential enemy. Their attention was therefore easily awakened to an alternative route which, though not so cheap, will afford them better security.

The Burmah-Siamese telegraph line now being constructed will have its terminus for the present at Zimmé (Kiang Mai), but is shortly to be projected to Kiang Tsen, a town on the Mékong River on the present northern frontier of Siam, about 200 miles from the Chinese frontier, and the proposed terminus of the Burmah-Siam Railway. The Chinese Company would be willing to extend their line in the south, now carried from Canton to Kwangsi and the Tonquin frontier, to the extreme south-west point of Yunnan, say to Ssumao, or whatever point might be fixed upon, provided the Indo-Chinese or Indian lines be extended over the intervening Shan territory, to meet the Chinese. This might be done from Kiang Hsen and Mandalay, giving a double line from Burmah. By one or both of these lines the Chinese would gain an alternative communication with Europe through India, and one safer than *viâ* Russia, at a moderate cost; and the commercial communities of India, China, and Siam, of the Straits and the Malay Peninsula, whose trade with China is so rapidly on the increase, would be brought into telegraphic intercommunication on practicable terms, which is by no means the case at present. That a considerable development of trade would be the result of the use of this new instrument can hardly be doubted, and to tap even a portion of the Chino-European traffic, and the whole of the Chino-Indian and Chino-Malayan traffic, would obviously be a most important gain to the revenues of the Indo-Siamese telegraphs.

The strategic importance of the connection will be obvious when it is considered that the sole dependence of Hong Kong and the Straits Settlements for their communications rests on cables which can be so easily cut by an enemy, and which at present pass through Russian Siberia and French Cochin China.

Recent events which have occurred in Burmah will make our influence paramount in that region, will strengthen our Eastern frontiers of India, help to bring order and security to the borders of friendly neighbours, China and Siam, and give us the opportunity of developing friendly relations with those Powers. On the north-western frontier of India steps are being taken which will greatly aid in giving security to our Eastern Empire.

To say that the designs of Russia make the statesmen of China and Japan uneasy is to greatly under-state the case. Russia is the nightmare of Chinese and Japanese statesmen, and the object of the inextinguishable hatred of the Manchurs. It is unnecessary to enter upon an explanation of the causes of this disquietude and dislike—they are much the same that appeal to Englishmen—enough that the Chinese and Japanese know quite well the Russian character and policy. They have not forgotten the loss of the enormous slice of Manchuria in 1860, and the repeated attempts to encroach on Japanese territory, notably in the same year 1860, when the Russians attempted to establish themselves in a fine strategic position commanding the Japan Sea, namely Tsushima (the Twin Islands). France they fear only as a somewhat restless and capricious Power, and as possibly open some day to a Franco-Russian alliance.

The interests of the three Empires of India, China, and Japan are now seen to be identical, the cardinal point of the policy of each being the maintenance of peace, which can only be upheld by a cordial understanding between the three. The internal reform and development of each country—the desideratum of India, China, and Japan alike—are only possible when peace and security are firmly assured, and when each is free from recurring menace and its dangerously disquieting influence. The chief interest of England in the East is her Indian Empire, though the commercial stake held in China is considerable, increasing, and of transcendant promise. With Japan our commercial tie is far slighter, but politically the best of understandings exists between us, and the English regard the Japanese with feelings of sincere liking and admiration, which they trust are reciprocated.

With a common policy they would form a combination that would prove an absolute guarantee for the peace of Asia. What cannot 530 millions of people with one common object accomplish, either in peace or war? To Russia they could speak with authority, whether their message was "Hitherto, but no further," or of a more peremptory character. England under the last Administration neglected the opportunity of consolidating the peace of Europe by accepting the friendship of Germany. She has a chance of redeeming in Asia the errors committed in Europe, but she has also a chance of repeating them with still more disastrous consequence. In China and Japan there are statesmen worthy of the name, while in India we are fortunate in having at the present critical time our ablest diplomatist, and one of the most far-seeing statesmen not only of this country but of Europe.

The folly, or rather the madness, of the view held by a certain

section of politicians that we can altogether avoid and ignore foreign affairs—which affect so closely every social question in our country, and concern every man, woman, and child in the kingdom—is made clear with a question of this sort, not looming ahead in the dim and distant future, but staring us in the face. It is my deliberate opinion that, should the country be ruled by a disunited Cabinet, with opinions as divergent as the points in the compass, we must abandon all hope of any early development of our relations and expansion of our commerce in this direction, and that China will leave us to face Russia alone. It is not unreasonable to predict that in that case we should again have procrastination, vacillation, surrenders, and enormous expenditure at the eleventh hour to avoid collision, and not improbably be drifted into an unnecessary and terrible war with Russia.

The CHAIRMAN: I need hardly remark, after the very able lecture to which we have now listened, that we shall do wisely in following the custom of this Institution in inviting discussion. If Captain Colomb is here, who has so often assisted us with his able pen in questions very similar to that which Mr. Colquhoun has discussed to-day, I will ask him to open the discussion.

Captain J. C. R. COLOMB: I obey orders for the purpose of giving others an opportunity to collect their thoughts as to what they propose to say. Unfortunately I did not receive a copy of the lecture in time to read it before the meeting, and therefore I can merely say this, that I think nobody who has at all looked into the history of the circumstances of the East can fail to see very strongly that the lecture we have just heard is one which should sink deeply into the hearts of every one who believes that we are an Empire and not a country, and who wishes us to remain so. Of course the whole history of the advance of Russia has been a complex one, and the more westerly portion of her advance has necessarily attracted chief attention. But her persistent effort through centuries, to get to the sea on the Pacific, and to get southward on that ocean, has not commanded sufficient attention from the statesmen of England as far as we can recognize the practical results of their policy. I will give one instance. Considering the ordinary possibilities of a combination brought about by the very facts and circumstances of our position in the East between France and Russia, I must say I think the way we treated China during her recent struggle with France is very much to be deplored. I myself believe that our real survival in the new civilization on the other side of the world alluded to by the lecturer very much depends upon our recognition of this fact, that the interests of China and England, as regards Russia, are identical. Of course, the civilization of China is very much behind our own, but if we are worthy of leading the future of the world we must face that fact. I most sincerely hope that we shall not shrink from our responsibilities. The first necessity of our not doing that is to understand them, and one of the great advantages and benefits that the lecturer has conferred upon us in England has been the placing of those facts clearly and accurately before the people of this country.

Sir ROPER LETHBRIDGE, M.P.: Ladies and gentlemen, I venture to add a few words to the tribute of praise and admiration, for the paper we have heard, that has just been offered by Captain Colomb, and I wish to speak in this distinguished assemblage of Service men, from another point of view than that of Captain Colomb—rather from the point of view of the civilian, and the commercial classes of England. I venture to do so because I have the honour to represent an important London borough that depends very largely for its prosperity on the commerce and the trade of the Empire. Now I think that Mr. Colquhoun has done a very important service to the country, and to his fellow-countrymen, and has shown himself a thorough patriot, by the courage and persistence with which he has brought before the people of England the very important political changes that are imminent in the Far East. I think he has done well this afternoon, especially in bringing those political phenomena before the notice of the representa-

tive men of the British Services. I had the honour of being present, and of taking part in the discussion, when Mr. Colquhoun laid a somewhat similar series of facts before the London Chamber of Commerce, the representatives of the trade and commerce of England, and I can bear full testimony to the deep impression that was produced by the facts which he laid before us, every one feeling that he had presented a picture which deserved the fullest and most careful consideration of all English statesmen interested in the trade of England. He has shown us that we are brought face to face at the present moment in Asia with one of the most important commercial revolutions that has ever happened in the history of the world. He has shown us that the results of the last few years, especially of the quarrel with France, and doubtless the tendency of Chinese civilization generally, have been to cause a reawakening of the national spirit and of the civilization of China. He has shown us that we are now facing a renaissance there, not only of commercial spirit, but also of military spirit. He has shown us that we are to have not only a development of telegraphic and other communications in China, but that China is ready to open up her railway system to the commerce and trade of the whole world. It is only for us to consider for a moment what Mr. Colquhoun has pointed out, that China means a population of some 300 millions, something like one-sixth of the whole human race; a population not only so vastly numerous as this, but also ingenious, industrious, thrifty, and frugal to an extent perhaps equalled by no other population on the face of the earth. What then must be the result to the trade and commerce of the world of such a reawakening, such an opening up of the country as that to which Mr. Colquhoun has directed our attention? It seems to me perfectly clear that whatever nation rises to the occasion, whatever nation takes upon itself, first of all, to make the railways of China and then to utilize those railways, to attach itself by political and commercial ties to the Chinese Empire and people, must inevitably become, from the extent of the population and from the genius of the Chinese people, the first commercial people in the world. And why, ladies and gentlemen, should that be the Russian or the French people, when the English people have always shown themselves the pioneers in every such enterprise? I trust that the statesmen of this country will not be behindhand in seeing the immense importance of the crisis to which Mr. Colquhoun has directed our attention. It is perfectly clear that if we do not seize this grand opportunity we shall be abdicating that proud position which England has always held in every part of the world, and I do trust that the interests of the Indian Empire, which are identical herein with those of England, will be fully considered. It is perfectly clear that both England and India will derive incalculable benefits from the opening up of China, provided only that we seize the opportunity, and that we ally ourselves closely with those Chinese statesmen of whose intelligence and genius Mr. Colquhoun has spoken, not only in resisting the advance of Russia or France in those regions, but in building up for ourselves a friendly community of interests with that immense Empire of China.

Major Grimstone: I should like to ask the lecturer one question, whether he considers that Burmah, lying between Hindustan and China, ought to be annexed or protected by England?

Colonel Malleson, C.S.I.: There is only one drawback to the entire satisfaction with which I, and I am quite sure every one in this room, have listened to the very able lecture which Mr. Colquhoun has given us, and that drawback arises from the fact that having often attended these lectures, having heard from this table truths uttered regarding the protection of our Empire in the East, which were undeniable and which were admitted, the statesmen of this country have on every occasion neglected to profit by the advice which has been offered, and have allowed matters to run on as if no such advice had been given. I sincerely hope that that may not be the case on the present occasion, and that we may not have to feel that this theatre is the theatre of Cassandra, where educated and instructed gentlemen utter truths affecting the protection of the Empire which are persistently neglected by the statesmen of this country. I recollect on a former occasion that when a lecture, unequalled for its ability, was delivered by a gallant Officer in this room, another gallant Officer whom I see before me rose and asked, "Is there any one here who thinks that the statesmen of this country will be moved by these warnings?"

Those statesmen did not listen to those warnings. I sincerely hope that we may not have to say so on the present occasion. I only wish that on the occasion of the delivery of lectures such as that which Mr. Colquhoun has delivered this afternoon, we could see members of the Cabinet sitting in the chairs around the lecturer and listening at first hand to the advice and instruction, which, if they heard, I am quite sure they would take the fullest advantage of. It is one satisfaction that on the present occasion no one has risen to impugn the soundness of the advice which the lecturer has given, and which has been so ably supported by the two gentlemen who rose to follow him in the course of the discussion.

Mr. DELMAR MORGAN: It has been a great pleasure to me to listen to the lecturer, though I must differ from Mr. Colquhoun in many things that he has said. During my travels in Central Asia I did not find that the Russian advance was a serious menace to this country. Seeing how very weak they, the Russians, are, what long lines of communication they have, and how very small their numbers for aggression, it is very unlikely that they would ever invade India. I have heard Russian Officers speak about it, but more from braggadocio than from any serious idea of ever invading that country. The lecturer also alluded to the Amur country. The extreme smallness of the population of Russia in Asia may be judged of from statistics that I saw recently in a work published on the Amur country, and which stated that the total population of that very large extent of country is only some 37,000.[1] Some years ago I read a paper in this Institution on the Russian advance along the Turcoman country, and I then said that I thought they would have a very difficult task before them. Events have marched, however, somewhat more rapidly than was then anticipated. At the same time, since that has occurred, they have, as I understand, been losing very heavily from sickness; we have heard that 80 per cent. of their men have been in hospital at Askabad and Sarakhs, or in the neighbourhood of those towns, and I am sure that they find it a much more difficult task to hold that territory than they imagined.

Captain FRANCIS BEAUFORT, R.A.: It may be slightly presumptuous in me to rise to address this meeting upon this subject, but I cannot allow a statement made by the last speaker to pass quite unnoticed as to the inability of the Russians to attack us. About a fortnight ago an article appeared in the *Moscow Gazette* on Russian affairs in Asia, giving, curiously enough, first of all a history of the Mounted Turcoman Militia, and then describing the great importance of this Militia as an attacking force in the direction of India. After having described the forces, it went on to say that there was a proposal absolutely drawn out for increasing these forces to 15 regiments of 6 sotnias with 160 men each of mounted cavalry, and 10 regiments of 5 sotnias each of infantry mounted on camels. The article ends by stating that they consider it would be absolutely impossible to prevent such a force as this, not only getting to Herat, but also to Quettah. I think, therefore, that the question of the inability of Russia to attack us in India is one that is past and gone.

Major BELL: I rise to say, if I may be permitted to do so, that possibly the lecturer's object to-day has been not so much to call the attention of statesmen or of soldiers to this matter as to bring it to the notice of civilians, and in the wisdom of that course I quite agree. The question is one of the advance of the civilization of those realms by the introduction of commercial venture. As we are aware, in many instances, such as, say, "The Labourers' and Artizans' Dwellings Company," direct profit is not so much immediately an object as doing good; so I think the lecturer is desirous of showing that the great lesson of this moment is, that if commercial men put themselves forward and take the initiative in the form of opening up railways and telegraphic lines, they will do more to civilize that country and produce goodwill amongst men than could be done by any other possible means at the present time.

Mr. CHARLES MARVIN: I rise to express my strong dissent from the remarks

---

[1] This number includes both sexes, and refers to the year 1869. It is at the rate of one inhabitant to four square miles, or rather less, taking the area of the province of the Amur at 164,000 square miles. This does not include the maritime province of Eastern Siberia, where the population, native and Russian, is still less.

which have just been made by Mr. Delmar Morgan with reference to Russian ideas with regard to the invasion of India. I do not think we need go to purely Russian sources to controvert the notion that Russia has no idea whatever of attacking India, because there is a whole literature existing on that subject. I might refer Mr. Delmar Morgan to a book published by Mr. Sutherland Edwards, a well-known Russian scholar, entitled "Russian Projects for the Invasion of India," and further to the testimony of Colonel Burnaby, who travelled in that part of Central Asia which was traversed some time ago by Mr. Delmar Morgan himself. I think it is a matter for very great regret that Mr. Delmar Morgan's experiences were confined solely to Kuldja and that part of Central Asia. I imagine that if he had penetrated to the Caspian region he would not have expressed the opinion which he enunciated a few minutes ago. On the map which is before the audience this afternoon, one can see very clearly the remarkable position that Russia occupies on the Caspian Sea, and the excellence of her communications, both behind and in front, for attacking India. For example, there is the route of the River Volga, which is open to steamboat traffic, and is covered with thousands of barges, all floating down in the direction of the Caspian Sea. No one will say that that is a very bad route of communication. On reaching the Caspian, there is the Caspian Marine, and afterwards there is the railway (which is shown upon the map) which has been completed as far as Askabad within the last few days. From Askabad to Herat there is simply a distance of 388 miles to be traversed by railway, and that distance will be further reduced to 240 miles next spring when Russia completes her railway communications to Merv. Thus we see that from the Russian position next spring at Merv the distance to Herat will be simply a matter of 240 miles across a very easy country, and from Herat there are only 400 or 500 miles of equally easy country to traverse in order to reach the English outposts. I imagine that when a Russian force reached the English outposts it would reach to all intents and purposes the British Empire in India: so that the long and difficult lines of communication to which Mr. Delmar Morgan referred may undoubtedly exist between Russia, through Siberia, to Kuldja and Kashgar, but certainly they do not exist through Russia to the Caspian, and the Turcoman and Afghan regions, to India. There was one point in the lecture itself to which I should like to call your attention. Mr. Colquhoun spoke of Russia not being a colonizing Power.[1] That is an opinion which is very often expressed, but I do not think it will bear thorough investigation. True, Russia does not ship away from her shores thousands of emigrants annually, but at the same time the Russian population is always spreading from the central provinces round about Moscow in the direction of the Caspian and Central Asia; for instance, about 8,000 or 10,000 Russian peasants yearly quit the railway terminus at Orenberg to settle in Central Asia. From the southern provinces I believe the stream of emigration to the Caucasus is about 10,000 or 15,000 peasant families every year. As a matter of fact, Russia has so far colonized the Caucasus that of the population of 6,000,000 composing the inhabitants of the administrative district of the Caucasus fully one-third are Russians or Cossacks. One other point is this. I do not think any one here will undervalue the moral value of the Chinese alliance; at any rate, no one has as yet attempted to controvert the opinion expressed by the lecturer. It may be assumed, therefore, that the opinion of the lecturer is shared by most persons present; but while myself fully concurring in what he has said, I think that the Chinese alliance ought not to be the sole method for defence of India. I have a very strong opinion myself that in this world we ought not to rely too much upon other people for assistance in times of danger. In my estimation, a man has only one safe ally to look to in this world—that is, himself; sometimes, of course, including his wife. To defend India, two measures are needed. In the first instance we require a strong position in Afghanistan for the Indian Army. We know very well that if Russia, on the completion of her

[1] Mr. Colquhoun's words were—"Russia is not an over-populated country throwing off its surplus population." In his reply, he explained that I was mistaken in supposing them to mean that she was not a colonizing Power. I therefore quote the particular passage I referred to.—M.

railways to Merv next spring, attempts to attack India, the whole of the Indian forces on the Indian frontier will have to be concentrated to meet Russia somewhere, either at Candahar or between Candahar and Herat. At the present moment the Government is very busily engaged in forming an entrenched camp at Pishin; but the majority of politicians and Generals I have met say that if Russia moves down upon Herat we shall immediately occupy Candahar. Now it seems to me that if Russia is able to concentrate an overwhelming force in the Caspian region[1] we ought not to content ourselves with simply a temporary camp: we ought to get into our permanent position as soon as possible, and that permanent position, I believe, in the opinion of some of our ablest Indian Generals, is some position on or near Candahar, stretching to the Helmund. But that is not all. The Indian Army would be engaged in defending whatever position was taken up near Candahar, and something, therefore, would be left for the Army in England to do. It is commonly thought that in the event of a war with Russia the English Army would co-operate with the Turks in an attack upon the Caucasus. Now I hold very strongly to the opinion that the day is completely past for doing any good whatever in the Caucasus region. Russia has almost entirely annihilated the tribes there; a rising would be almost impossible; and even if we penetrated to Tiflis we should not sever the Russian communications stretching between Moscow, *viâ* the Volga, and the position she would take up in or near Herat. Consequently, a campaign in the Caucasus would be a mistake, and would have no effect whatever upon the general operations in Central Asia. Therefore I think, in the event of a war with Russia, the English Army would have to co-operate with the Indian Army from the base of the Persian Gulf. In that case railways stretching from the Persian Gulf would be essential, and I think they should be taken in hand by the English Government as soon as possible. If I may say another word, it is simply this. Within the last few days a statement has gone forth, on the authority of an eminent personage,[2] that neither England nor Russia could occupy Herat in their present condition of railway communication except at a vast outlay. That may be possibly the opinion of the English Government as regards India, but certainly as regards Russia I am persuaded the majority of Russian Generals will altogether scout the notion. Russian Generals, with scarcely any exception, believe that Herat could be occupied with very little difficulty, and even if there be any difference upon that point they certainly all believe that it could be held by a Russian garrison with remarkable ease, particularly as the railway, which is now finished to Askabad, could be extended easily to Herat within a twelvemonth.

Mr. E. Cazalet: It is an old saying that nothing is perfect in this world, and that is applicable even to our own institutions, and to our own free press. What I mean is that the most ingenious and practical ideas suggested to Russia how to increase her power and how to injure British interests in Central Asia or elsewhere have been put into the minds of Russian officials by what they have heard and read in this country. It strikes me that we are somewhat in the position of a claimant who considers it his benefit to instruct his enemy's solicitor against himself. The danger does not lie principally, although it may to some extent, in Russia or in Central Asia; the danger is at home, and it proceeds from the absence of a *uniform foreign policy*. Look at Bismarck and the manner in which things are managed in Germany, how the interests of Germany have been maintained, and how the dignity of that country has been raised of late years. If there were sufficient patriotism and self-abnegation to have a permanent Chancellor for Foreign Affairs, irrespective of Party, be he Lord Salisbury or be he Lord Dufferin, the power of England in foreign matters would be such that we should have no trouble either with Russia or anybody else. Parties carried away by political feelings might squabble over home affairs, but foreign matters would be in the hands of a man who would be supported and respected by the whole country.

---

[1] "And on the Afghan frontier," *vide* "Russia's Power of Attacking India," a pamphlet which puts the case in an ampler form. London: W. H. Allen & Co., 1885.—M.

[2] Sir Henry Rawlinson.

The CHAIRMAN: I think we are all very much indebted to Mr. Colquhoun for his lecture. I cannot say with what interest I have listened to it. For eleven-and-a-half of the most important years of my life I was rubbing shoulders with Russia, and I acquired large experience of her during that time, some of which, perhaps, I had better keep to myself. I was also in China when Colonel Ignatieff, as he then was, signed the treaty which filched a portion of Manchuria, as was properly said by the lecturer, under the cover of English and French guns. Before I say anything more I would recommend anybody who wants to know the real history of the Russian attempt to steal the Island of Tsushima, to read an article by my old friend Lawrence Oliphant, in the last number of "Blackwood." I happened to read it three or four days ago, and the moment I got Mr. Colquhoun's paper I determined to mention it here, in case others had not had the pleasure of reading it. There was one conclusion at which I arrived during my residence in Berlin from very large intercourse with Russians, and with those who knew Russians better than I did, and that is, that one feature which lies at the bottom of all Russian aggression on England is purely and entirely commercial; it is the desire to close every country on which Russia can lay her hand to English manufactures. Very soon after I came home from Germany and established myself in London I dined at a large City dinner, where I had next to me a gentleman whose name was perfectly familiar to me as a very influential and wealthy merchant in London. It was at the time when certain measures were taken by the then Government to express a certain opinion on the Russian advance towards Constantinople, and we got into conversation on the question of the Russian movements. He said with rather a piteous tone, "Why won't you let poor Russia alone? Why should you not let Russia do what she pleases?" I turned on him rather sharply, and said, "I happen to know who you are. I happen to know that you are a mercantile man of very considerable importance and influence, and I now tell you what you do not seem to know: the whole point of Russian aggression on England is to destroy your commerce, to prevent you from sending English goods into countries over which Russia can gain the control." And I believe I have come to a perfectly right and fair conclusion. I was very much struck with another point which came under my notice several times, viz., the extreme probability of Russia forming an alliance with France. And I found this also, that notwithstanding their extremely courteous and kindly manner to us as individuals, whenever we come in contact with Russians, the Russian hatred of England is not to be extinguished—that it is inextinguishable. And why? They were perfectly ready to shake hands with the French, because the French went into the Crimean War for the idea of their Emperor, but they hated us because we went into the Crimean War on principle. If the French were prepared to throw up the sponge and get out of the Crimea as quickly as they could, we were ready to have gone on if they had only remained to back us. The true opinion respecting Russian advance towards India, in my opinion, and you may take it for whatever it is worth, has been expressed over and over again by a great Indian authority, who is firmly of opinion, I believe, that the Russians have no further intention of aggression upon India than that they should so occupy us there that we cannot interfere with their designs in Europe and Asia Minor. That we should form an alliance with China is, I think, a notion with which none of those who have been in China and have served in China, as I have, will disagree, and there is one small fact which will greatly facilitate that result. We occupied Peking, certainly, for six weeks—I am not sure whether it was for longer—we burned the Emperor's palace, and we certainly knocked their forces to pieces in a way which could not be pleasant to anybody; but I perfectly remember the remark which was made when we were about to evacuate Peking, which came from the common people: "You have been here for six weeks, and not a single poor man has been robbed of a cash," a "cash" being the smallest possible coin that the human intellect can conceive. I believe we left behind us after that campaign a very friendly feeling amongst the people to whom we had gone. I think, perhaps, Mr. Colquhoun will be desirous of saying a few words in reply, after which I shall have the pleasure of proposing a vote of thanks.

Mr. COLQUHOUN: Sir Beauchamp Walker, ladies and gentlemen, I do not wish to weary you with many remarks, but I should like to say a few words in reply

to what has fallen from the various speakers, and especially from Captain Colomb. I have not the pleasure of the acquaintance of that gentleman; but of his writings, I may say that ever since I have taken an interest in the affairs of the nation, and especially of the militant services, I have read everything that has come from his pen, and I think no man has done greater service to the country, in the matter of national defence, than Captain Colomb. His opinions on all questions, on which I have any right or title to pronounce any judgment or hold an opinion, I have always considered to be exceedingly sound and far-seeing. Captain Colomb is well known to most of you here as a writer who has made the question of our Colonial Empire entirely his own. In this particular question then, as regards the value of the friendship of China, I think his opinion is of great value, and when I was going to lecture here this afternoon, I took the liberty of asking him to be present, feeling sure that anything that he had to say would be very valuable and much appreciated. Captain Colomb told us that it may be taken for granted that the policy of Russia is to place herself in an advantageous position on the frontiers of the two most populous countries in the world, and the two richest Empires of Asia, for the purpose, not perhaps of directly attacking those Empires, but of being able at any convenient time to exercise pressure—that is, to menace and coerce them—and by that means gain what she wants elsewhere. If this be realized as the whole basis of Russian policy, and kept clearly in mind, it will be readily understood that, while Russia is restlessly pressing forward in her endeavour to place herself in such advantageous positions both as regards India and China, the positions she desires elsewhere are to be found, not on the Indian littoral, or on the coast of China itself, but in the extreme West and extreme East—in the neighbourhood of Asia Minor and the Levant, in the Persian Gulf, and in the Sea of Japan and the China Sea. Captain Colomb very properly drew attention to a point which it seems to me has never been publicly brought forward by any writer, and which, so far as my experience goes amongst the commercial community—and I have a very considerable experience of that section of the public—has never presented itself to their minds. That is, that although Russia is pressing forward on the Afghan frontier, and the attention of our military men and politicians, who take an interest in national defence, is concentrated entirely on that point, we may make up our minds that when Russia chooses to take the next opportunity again to exert pressure—that pressure which begets feelings of danger and disquietude throughout our Indian Empire—she will not then seek to attack India itself, but we shall see her attacking our interests either in the China or Japan Seas, or else in the extreme west. I ask your attention for a few seconds to the consideration of the meaning of a forward Russian movement being made in the China and Japan Seas. I have no doubt if we could ascertain the opinion of the majority of our countrymen to-day they would say: "Well, let Russia do what she likes there; it does not matter." But when we consider that in that region we have not only a rapidly increasing commerce with China, the sole country now open to our energies in which we can hope for any large commercial expansion, and when we further consider that that growth of trade is an absolute necessity for this country with its rapidly increasing population, with foreign competition growing keener every day, and with hostile markets closed against us, the value and importance of strategical positions in the China Sea will become more and more evident to us. It is in China alone, in my opinion, that we can look in the future for any great expansion of our commerce, and for any considerable strengthening of our position in Asia. It is therefore impossible that we can ever permit Russia to come down and occupy a strategical position which would simply mean a lasso cast round the throats of China and Japan, and a menace to our enormous and rapidly growing interests in those regions.—With regard to the remarks made by Mr. Delmar Morgan, I think what I have already said will answer what he had to say. I think he must be the only man in this theatre at present who is of the opinions put forward by himself. As for making a special plea on behalf of Russia, on the score that she is anxious to avoid war, I think every one who is at all acquainted with Russian policy knows that she is exceedingly anxious to avoid war so long as she can get her own way without going to war, and she takes precious good care to try and get, and generally succeeds in getting, that way. Therefore, all we have to

do is to watch closely the movements of Russia, and always to bear in mind that the time when Russia will move is not when we are free from difficulty and danger, but when we are *in extremis*, when we are in the throes of some great political or other conflict. As for the *enormous* sacrifices in men and money that have to be made by the Russian commanders in crossing those *vast* steppes and desert territories in order to get to the objectives of their movements on India and China, to which Mr. Delmar Morgan directed our attention, I think his argument surely tells against himself. Why should a country like Russia, not over-populated, not seeking any natural commercial expansion, make these enormous sacrifices, unless it has some design when the end of this most costly movement be attained? The very sacrifices that they have made and are continually making in crossing these regions show conclusively that there is something which they consider to be of inestimable value to be gained at the end.—Mr. Marvin, in the remarks he made, fell into an error in saying that I had indicated that in my opinion Russia was not a colonizing Power. My remarks were directed to France and not to Russia. Whatever Mr. Marvin says I am sure is listened to with interest by every Englishman, because he has done a great deal to popularize in this country the truth regarding this question. He is, however, mistaken in assuming that my opinion, in regard to this Russian question, is that we should depend *solely* upon a Chinese alliance. I should be the last man to advocate any such thing. My object in placing this paper before the members of this Institution was, as a civilian, merely to put before them the political, social, and other aspects of the situation, to present to them certain facts on which military experts should build up a policy of defence. It will be noticed that I have not presumed to sketch out any particular military line of action for protecting our interests. That I have left entirely to military experts. So far from relying solely upon China, I am personally of opinion that we have to defend our interests in the East, and in India especially, in a very different way. But I do not believe that the future conflict with Russia will be fought in the neighbourhood of Afghanistan. When we come to face Russia, it will have to be done in the West and extreme East. I hope that having cemented a solid friendship with China, having developed our intercommunication and given a good earnest that we are prepared to give as well as take in the matter of international relationship, we shall move with them in resenting any forward movement or attack of Russia. I believe that the conflict, should it come, will be fought out in the region of the Amur with Chinese forces directed, I trust, by English Officers, and in the Black Sea, and I hope also in the Baltic.—Mr. Cazalet drew attention to the possibility that gentlemen like myself, who point out the position of affairs in Asia as regards Russia and England, do an injury to their own country in this regard, that they lay bare to Russia the weak places in our armour. It is a remark that you often hear made, but I have invariably found it made by men—I am sorry to have to say so—who do not take any great interest in their own country. I am sure that Mr. Cazalet is not one of these, from what fell from him afterwards, but as a rule it is as I say. No more foolish argument can be used, because any one who knows Russia or the Russians is aware from bitter experience that they are aware of our weak places very much better than we are ourselves. I have only recently returned from a long sojourn in China, where I had occasion to meet Officers of the different squadrons in that part of the world, amongst others the French and the Russians, and I found when matters were in a very critical position last spring, when Consols were 95½, and when it seemed very possible, to say the least, that war might break out between England and Russia, that while we knew exceedingly little regarding Russian Siberia and the Amur Provinces, while we knew nothing regarding the condition of Vladivostock, the Russians had a complete Gazetteer of every single one of our colonial possessions and strategic posts, and of the precise condition of our armaments and garrisons. So complete was this Intelligence-Guide, that, as I wrote to the *Times* on that occasion, it would have been a perfect godsend if it could have been placed in the hands of our own Officers. Such was the position of affairs then. I think, therefore, that every one here will agree with me that we lose nothing by laying bare to the Russians our weak places, because they are already aware of them; but we may do a very great deal of good by trying to instruct and interest the middle and artizan classes of

this country in what is so really and truly a question of national importance. —A gentleman asked a question regarding Burmah, whether I considered the annexation or protection of Burmah by England the better course. I believe the rules of this Institution forbid our trenching upon politics, and it would be almost impossible to answer that question without doing so.—In conclusion, with reference to the exceedingly apposite remarks that fell from our Chairman, who has had a long experience of Continental countries and of Russia, I think that every one in this country, who takes any interest in this question, the more he looks into it, must become the more convinced that the *raison d'être* of Russian policy in making all these sacrifices is to get seaports, not for the purpose of building up patiently and during a generation of years a commerce of their own, but of being in a position to threaten, cripple, and seize upon ours. If the mercantile community, the artizans and working men generally of this country, could only once get to understand that, I think we should be in a more secure condition. In sketching the outcome of the Franco-Chinese War, I passed over very briefly the possibility of a Franco-Russo alliance, but still I referred to it. I passed over it lightly because in the present unsatisfactory condition of politics in France, and the unfortunate position of affairs for that country in Tonquin, I did not think it right to criticize too severely, or to throw stones at our neighbour; but it was impossible not to say a few words to show that at any time a Franco-Russo alliance is quite within the range of possibility. I firmly believe that if the Tonquin Expedition had not turned out as it did, if everything had gone smoothly, and if M. Ferry's brilliant ideas regarding a French Indo-Chinese Empire had met with anything like the success that he anticipated, we should undoubtedly have had a Franco-Russo alliance, and we should have had that alliance actively engaged against ourselves. When matters were so critical between Russia and ourselves last spring, I had occasion to be in close contact with Chinese and Japanese statesmen at the time, and I have every reason to believe that M. Ferry did then contemplate such an alliance. I need hardly point out the exceeding danger that would lie in our having to deal with Russia in the West, not only in having to strengthen and defend our north-western frontier in India, in order to keep that Empire secure against Russian menace or attack, but in having added to that another Western Power, a potential enemy on our eastern flank. However, recent events which have occurred in Burmah, the occupation of the country and the masterly manner in which Lord Dufferin has dealt with the question, have removed, I believe, that imminent danger of a Franco-Russo alliance.

The CHAIRMAN: I am sure you will all agree with me in offering to Mr. Colquhoun our warmest thanks for the instruction which he has communicated to us this afternoon.

GEN

SUG

I TH
larg
in th
serv
that
arm
deve
grea
of th
patr
Arm
of w
to r
of w
succ
mitr
stan
S
Serv
men
bein
I ha
at o
Wit
be e
adop
I
over
rais
the
mac
only

SPECIAL LECTURE.

Friday, November 13, 1885.

General the Right Hon. Viscount WOLSELEY, G.C.B., G.C.M.G., Adjutant-General of the Forces, in the Chair.

SUGGESTIONS FOR THE ADOPTION AND ADAPTATION OF THE SINGLE BARREL MACHINE-GUN FOR THE VARIOUS BRANCHES OF LAND SERVICE.

By Major M. R. West, R.H.A.

I trust I may not be considered presumptuous in taking up so large a question, but my reasons for so doing are my sincere belief in the great undeveloped power and value of the machine-gun for land service; that there has been already too much supineness in the matter; that no more time should be lost; that "forewarned should be forearmed;" and my heart-felt desire to in any way bring to the front and develop the efficiency and latent resources of the Service, and get the greatest possible power out of each branch, and thus add to the power of the kingdom. I also think that it would be highly culpable and unpatriotic on our part not to have developed every resource to have our Army as efficient as possible at all times, and before the breaking out of what must be a great struggle, instead of at the last moment having to rush into the adoption and adaptation of machine-guns, the value of which has been admitted by many of our most experienced and successful Officers. The French in 1870 found this difficulty with the mitrailleuse, a weapon which, even under unfavourable circumstances, did terrible execution.

Speaking without partizanship, as my only object is that the Service should be supplied with the best weapon in every way, I merely mention that since September, 1880, when I saw some experiments being conducted at the Royal Arsenal, Woolwich, by Captain Gardner, I have always believed in the value of machine-guns, and recognized at once a marvellous increase of power to each branch of the Service. With regard to Captain Gardner's single barrel, I do not think it can be excelled for simplicity, accuracy, and portability. But any weapon adopted should fire ordinary small-arm ammunition.

I do not feel the least daunted at the amount of prejudice to be overcome, or at the various difficulties and objections that will be raised by even intelligent and experienced Officers of all branches of the land service, but, with respectful deference to such, I believe the machine-gun should be adopted for artillery as a powerful auxiliary only (including horse artillery and field batteries, and garrison artil-

lery), cavalry, and infantry. I advocate the single barrel, believing it to be the best for mobility, simplicity, and efficiency, and that (we'll take the single barrel Gardner, as I know most about it) a single barrel capable of firing from 200 to 300 rounds per minute would be a better weapon than any other in not exhausting ammunition unnecessarily, or putting two or three bullets into one man or horse. At Ulundi there were many proofs of this, on examination of dead Zulus.

As to the objections that will be reasonably raised, the chief I imagine will be the additional weight, and that it would be quite impossible to make anything like effective practice at a halt from the breathing of the horses, and on the move from jolting and unevenness of the ground. With regard to the additional weight of machine-gun and ammunition, I do not think it at all insuperable, and that the additional power obtained would more than compensate: say, gun and 1,000 rounds, on foot-board of limber, 200 lbs. Two machine-guns on flank limbers would be of immense value, and in covering a retreat could be worked together, as a division of a battery, and check an enemy pressing on. They would be able to fire at the halt much longer than could be safely done by the field gun itself, and in moving at even a gallop would still be able to keep up a continuous fire. As regards the accuracy of fire at a halt, I do not think it is worth while now going into it. As to firing on the move, I do not think there is any more reason against it than a man-of-war suffering from the motion of the sea firing at a moving target, and naval Officers will tell you that they can cut a flagstaff pretty frequently with a 10-inch gun at 1,500 yards. Again, it is not the true aiming so much that makes the accurate shooting with a moving or movable weapon, as firing at the absolute right moment, as I have seen exemplified at revolver practice. In firing off a carriage on the move the hand and eye must work together; but practical results are the only thing to decide this question. Thanks to the courtesy of Colonel Nairne, Commandant of School of Gunnery, Shoeburyness, I have had the opportunity of firing off a limber, on the move and at the halt, and from the results am satisfied of the practicability of the scheme. On the sands, having for objects targets with a front of 24 yards, and three rows of infantry dummies, 50 yards apart, and 3 to 5 yards interval between dummies, out of a total of 70 shots at halt, smart "trot," and "gallop," 15 bullets were put in, 3 and 2 respectively in two rounds of 10 each (at infantry dummies), and in one round of 10 at targets, four hits when going at a smart trot.

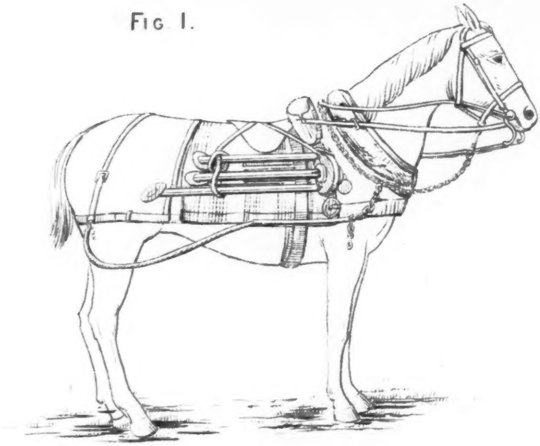
For field artillery (including horse artillery and field batteries) I propose a single barrel, adapted as now suggested, to be used on and fired from gun limbers, and claim that it will almost totally do away with necessity of escorts, thus rendering field artillery more self-reliant and independent, that the fire from a machine-gun would be a very valuable supplement to shrapnel fire, and would altogether alter the hitherto incontrovertible fact that artillery as an arm was useless when limbered up, whereas now it can prove "Nemo me impune lacessit."

eving
that
it) a
inute
nmu-
an or
on of

agine
ole to
ng of
ound.
nuni-
ional
1,000
flank
could
nemy
than
ven a
gards
now
s any
otion
l you
un at
nakes
ng at
olver
must
this
ndant
ity of
esults
aving
vs of
ween
and
two
of 10

ies) I
n and
away
self-
l be a
alter
seless
pune

FIG. 1.



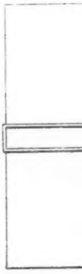
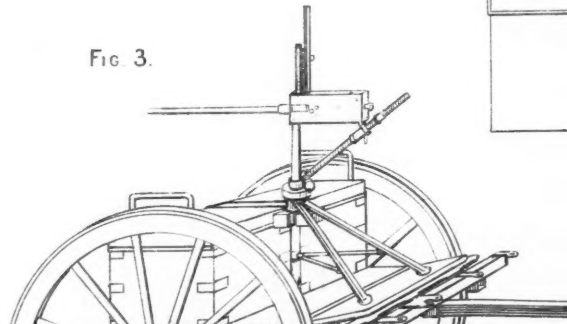


FIG. 3.



Harrison & Sons Lit

Fig. 2.

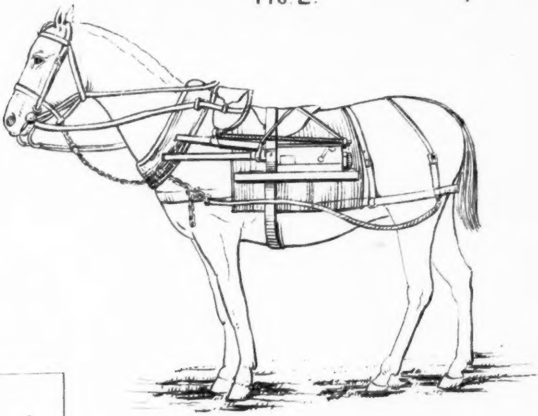


Fig. 4.

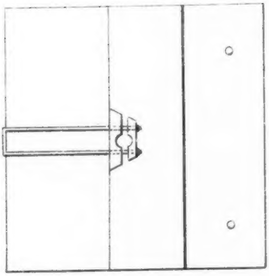


Fig. 5.

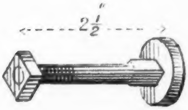
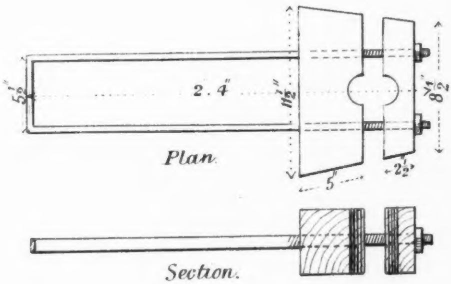
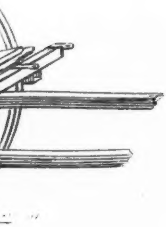


Fig. 6.





Harrison & Sons Lith. St Martins Lane W.C.

II

c
ler
ob
tio
a
th
he
gu
eff
fir
me
co
on
th
eff

R
gu
gu
sh
us

la
si

b
p
b
ir
r
n
t
t
V
a

n

c
b
s
l
a
j
t
a

i
i
a

Garrison Artillery and Royal Engineers.—As to garrison artillery, the value of machine-guns for flanking of ditches must be obvious, but I would suggest their being also brought in conjunction with Royal Engineers, to the assistance of the latter, say, where a fort may have been constructed in an injudicious position, and that machine-gun stations should be constructed on commanding headlands and promontories, to keep down the fire of the machine-guns from tops of hostile ships, and more than counteract their effect. I have in my mind's eye Fort Camden, Cork Harbour, the fire from which, owing to the present position in which the guns are mounted, is masked so far as any effect it would have on any ships coming up along the eastern coast. Had the fort been constructed on one of the headlands to the south, and nearer to the entrance to the harbour, the fire of all the guns would have been thoroughly effective on any shipping that might approach.

Under the present construction of the fort, as the only three 10-inch R.M.L. guns which could be effectively used are *en barbette*, the gunners serving them would speedily be knocked over by machine-guns from tops of hostile ships; it is therefore very desirable that this should be obviated as far as possible. If machine-guns of 0·450 were useless, the Hotchkiss 6-pr. quick-firing gun would be very effective.

Landings.—Machine-guns would be most valuable in resisting landings, and should be able to do so successfully; from the other side they would be also valuable in covering landings.

Cavalry.—With cavalry, say two machine-guns per squadron would be a wonderful increase of power, and would prove invaluable for outposts, detached posts, advance and rear guards, for holding defiles and bridges, also in attacking the latter, clearing and holding streets, and in the hands of an enterprising, intrepid leader, and one ready of resource, there is no knowing the influence a small powerful force might have on the results of a campaign, from being able to paralyse the efforts of the enemy's cavalry to obtain information, and being able to seize and hold valuable detached and advanced positions. Colonel Wardrop's work near Gubat was a specimen of what can be done by an enterprising, intrepid leader.

Occasions, too, might arise where all the machine-guns of a regiment could be massed together, and form a battery.

No doubt objections will be made that our cavalry is already too complicated in equipment of arms, with lance, sword, and carbine; but again I assert that the additional power will more than compensate, and give great self-reliance and independence. I advocate the pack both for gun and ammunition, and believe that artillery (horse artillery and field batteries) and cavalry will most benefit by the judicious application of machine-guns; my reason for so saying is that their mobility will enable these branches to more quickly concentrate and take advantage of the increased power.

Infantry.—As an artillery Officer, I feel a great amount of diffidence in approaching the subject as regards the application of this power to infantry, more especially when there are so many Officers who, from their skill and experience, are so much better qualified in every

way to give an opinion; but, in my humble opinion, the machine-gun must be a most powerful auxiliary, and for minor movements would to a great extent render infantry independent of artillery, though in large campaigns it would have to give way to artillery proper, owing to the greater range of the latter.

In all campaigns, whether against a semi-barbarous or civilized foe, a free use of this weapon should, in the hands of a skilful commander, go far to revolutionize modern warfare.

The value of this arm for outposts holding detached posts, defiles, bridges, attacking the latter, and for street fighting, would be very great, and in extended movements for holding positions should by a judicious cross-fire be able to render positions impregnable, and in attacking positions by a continuous well-directed fire should do much to demoralize and shake the courage of an enemy.

Knowing I have the sympathy of Lord Charles Beresford, R.N., in this matter, I take the liberty of quoting from his lecture, at p. 942, No. CXXVII, of the Journal of this Institution, as follows:—

"The Duke of Wurtemberg, in a description of the battle of St. Privat, says, 'During the action of Ste. Marie-aux-Chênes Prince Hohenlohe, commanding the Artillery of the Guard, had collected 84 guns opposite St. Privat and cannonaded the French position with great effect, at first at 2,640 paces, and afterwards at 2,000 paces. About 5 o'clock in the afternoon the Commander of the Guard considered the enemy to be sufficiently shaken for him to risk an assault across the open and gently ascending ground. The 4th Brigade of the Guard (Kessel) first moved forward from Habonville in the direction of St. Privat in line of columns in two lines with skirmishers thrown out in front, and a quarter of an hour later the advance of the First Division of the Guard (Pape) commenced in the same formation from Ste. Marie-aux-Chênes, distant about 2,640 paces from the main position. Habonville is about 3,960 paces, therefore the three brigades came about the same time within the effective reach of the enemy's fire. The front of attack included little more than 2,000 paces, so that there were about ten men to the pace. This was, however, the closest formation of attack employed by the Prussians in the campaign.'

"The effect of the enemy's fire even at a distance of more than 1,500 paces was so murderous that, according to the accounts received, nearly 6,000 men fell in ten minutes, and the advance had to be immediately discontinued." If the fire of the mitrailleur batteries was so murderous, it surely must be worth our while to adopt and adapt a weapon which will produce a similar murderous fire without sacrificing our field artillery as the French did theirs to the mitrailleur batteries.

The Central London Rangers have been setting us an example in using machine-guns, and, doubtless, they will soon form part of the equipment of many enterprising Volunteer corps, and will add much to their efficiency.

Adaptations for 9-pr. Limber.—The long leg and stay of the Gardner tripod being taken off, its place is taken by a three-sided piece of

flat iron, fitted to go round centre box of gun limber; on the ends of the long sides of these pieces of iron, which are rounded, there are threads to take nuts, a piece of wood with holes cut through is slipped on these ends, this piece of wood being of the size to bring the socket of gun into an upright position, another piece of wood is slipped over ends, and nuts, then screw the arrangement tight, the two short legs are then screwed to the footboard; in this position the limber boxes can be opened when the gun is in a central position, and gun can be fired all round.

Adaptation for Cavalry or Infantry.—With an ordinary artillery shaft horse and harness, two horse sheets, a little pack thread, and two straps (each in two pieces), I adopted an expedient which did very well; the sheets were folded and attached over the horse's back and along the flanks to save horse's flanks from friction of pieces of gun; the barrel of gun is put through shaft tug on near side, and the socket of tripod through tug on off side; belly band of shaft tug is then fastened, and the two straps referred to put diagonally as stays across pad from near shoulder to off quarter, and from off shoulder to near quarter, when the gun and tripod were found to travel very well, and weight pretty evenly distributed.

Cavalry would use horses, and infantry mules or ponies, or even men, for transport of gun and ammunition.

The adaptations suggested by me are the most simple and of the rudest and cheapest description with means at hand, but when the machine-gun is adopted for artillery and cavalry, doubtless the socket will be let into a cylinder between the limber boxes, cylinder being on axletree bed.

For cavalry and infantry a very efficient simple pack could readily be devised, merely bearing in mind that the various parts should be as close as possible to horse's flanks, and nothing projecting unnecessarily, to enable animal to be brought readily through thickets and wood.

I shall be only too pleased if these rough notes and suggestions may be the means of bringing into prominence this valuable undeveloped power, and thus enormously increasing the power, independence, efficiency, and self-reliance of all branches of the Land Service.

Captain Gardner's Experiments at Berlin.—Captain Gardner some time ago having been requested to proceed to Berlin, did so, and on being introduced to the military authorities, proceeded to expatiate on the advantages of his gun, but was told that had they not thought it was the best, they would not have sent for him, and then desired to see some experiments, which accordingly were carried out, with one single and two double-barrel guns as a battery; the dummies at about 800 yards were set in motion by reels, with a view to seeing the effect on infantry attempting to take the battery, the result being very favourable to the battery.

The second experiment was at dummies representing cavalry, developing an attack out of a wood; this again was very satisfactory to battery.

A third experiment was at two pieces of fibrous wood, 16 inches square, at about 50 yards distance, pieces one behind the other, the result being that the front piece was cut through in 28 seconds, but some of the bullets having only penetrated into the second piece of timber, formed a foundation on which all the other bullets stuck; the German authorities were apparently pleased at the results of experiments.

Russian Government and Gardner Gun Company.—Some months ago the Russian Government were desirous for Mr. Norton, the late manager of Gardner Gun Company, to proceed to St. Petersburgh, and within the last seven weeks, Mr. White, of the same Company, has been to St. Petersburgh concerning this machine-gun.

Experiments at Maiden Castle, near Dorchester.—My first mounting of single barrel was on a T-shaped wooden frame removable from limber, being attached by three straps; it took half a minute to have gun off limber and on ground in action. The very first shot I fired from it was at 100 yards, at an ordinary 6′ × 2′ target; I aimed to strike about 3 feet from the ground, which it accordingly did; I then took an envelope I happened to have in my pocket, plaistered it with mud, and stuck the centre of envelope on the mark made by bullet, and, without looking over the gun, fired, when the envelope was struck. I repeated this with another round with like result, and then was satisfied as regards mechanical accuracy and recoil; on other occasions I fired up to 800 yards, and allowed non-commissioned officers, gunners, and some Volunteers who happened to be on the range, also to fire, and always with good results.

Opinions.—I desire to draw attention to the opinion expressed by our distinguished Chairman, of the "enormous future of the machine-gun in the field," stated at p. 482 in No. CXX of the Journal in these words:—

"I quite agree as to the value of the machine-gun in the field. I believe there is an enormous future for it, for the very reason that it will increase the effect, and will aid in the power of long-range infantry volley-firing. The machine-gun will take the place of considerable bodies of men, and when supplied with plenty of ammunition, which it is the duty of those who have charge of an army to provide, I believe there is a very great future for the machine-gun, and that that General or that nation which knows how to develop and make use of it will in the future have a very great opportunity—an opportunity that has never been made use of by any one before."

Also to the opinions of Officers of different branches of the land service, quoted in the valuable and interesting lecture given by Lord Charles Beresford, R.N., entitled "Machine-Guns in the Field," which is printed in No. CXXVII of the Journal.

A Colonel commanding an infantry regiment in India writes as to the use of machine-guns:—

"They could on all occasions be used as an escort for artillery. The conditions of modern warfare necessitate that the assault on a position must be preceded by a heavy artillery fire, sustained almost

up to the moment of actual collision. It follows, therefore, that for the proper and effectual performance of this duty the artillery must move well away and act from a flank, as no infantry in the world will stand artillery firing over their heads for any time. This being so, necessitates the employment of a large escort, and there can be no doubt, if you could move infantry about quick enough, it is the best of all arms for such work. You cannot transport infantry with sufficient rapidity, and therefore in most instances cavalry takes the duty. Now if you can mount and move machine-guns as fast and over the same ground as artillery, what better escort could they have, as, to all intents and purposes, they would have always on their exposed flank as many infantry as may be considered necessary? Before moving into position, of course cavalry would have closely reconnoitred and searched the ground selected for the massed artillery to act from; but once having done this, they could safely leave the artillery protected by the machine-gun, and be free for other employment on other portions of the scene of action. Had there been a couple of 10-barrel Nordenfelt guns with the artillery at Maiwand, the guns would never have been lost, the cavalry would never have been kept so many hours inactive under a heavy artillery fire, and the day would have been saved." He goes on to say:—

"With cavalry and mounted infantry machine-guns would be invaluable. Cavalry, to be of any use, must, in an enemy's country, be a long way ahead of the infantry and the rest of the army, and this distance is only limited because cavalry is not a self-contained arm. With two 10-barrel Nordenfelts (Plate XXIX, Fig. 1) permanently posted to each regiment, which can manœuvre and move with it, how economically yet how enormously has the power of cavalry increased! It has practically always with it 150 infantry who can be brought into action at any moment, and not a single man has to dismount. They are all in the saddle ready to complete any advantage gained by their machine-guns.

"Fancy the advanced cavalry of a large force armed as above working against an enemy's cavalry having no such adjuncts. The result is obvious, and the force with the adjuncts would assuredly penetrate the enemy's cavalry screen, get at the main body and hurl it back on to its infantry, a disordered mass. I think few will contend that a brigade of cavalry of three regiments with 6 machine-guns, representing 450 infantry, would not overwhelm a much larger force without machine-guns. Both sides would naturally be provided with horse artillery, but being of necessity without artificial cover, I maintain that you could (ground being favourable) work the machine-guns up to within their own range of such artillery, and they would, as infantry would do, drive them out of the field.

"To me it appears as if cavalry is the arm which will profit most by the introduction of machine-guns. It will, to them, supply a long-felt want, and will render them a self-contained force . . . Being infantry without nerves, they will find a happy home and a welcome in this portion of an army.

"It seems to me that these guns are bound to be an all-important

factor in deciding the result of the next big European war; and the nation which employs them, and thoroughly understands their technical working and organization, will assuredly come off victor. The result will be, if anything, more electrical and startling than the defeat of the Austrians by the Prussians in 1866: a fact which was entirely due to the superiority of an indifferent breech-loader over a good muzzle-loading rifle."

A Colonel of Artillery gives his views as to the use of machine-guns as adjuncts to batteries when escorts are not available:—

"A machine-gun to be of any use for this purpose must be able to manœuvre at the same pace as the battery which it supports. With mountain and heavy batteries, whose pace is a walk, this is perfectly possible by carrying the guns on pack animals. To batteries of this class I think they would be valuable auxiliaries (Figs. 2 and 3).

"For mountain artillery they would be specially suitable. They would greatly increase offensive and defensive power at ranges from 100 to 1,500 yards. Their chief use would be the defence and attack of defiles, the defence of small fortified posts such as we held in the line of communications in Southern Afghanistan, and in repelling attacks at close quarters, as at Ahmed Keyl and Maiwand. There is the more reason for their use here, that the shrapnel fire of these batteries is weak.

"For horse and field batteries the problem is more difficult. No toy carriage with small wheels can be relied on for transport purposes. Such a carriage can be used and should be used as a fighting carriage for a machine-gun in the same way as it is used in the mountain artillery. If, however, a very light gun with a good tripod arrangement, such as the 3-barrel Nordenfelt, were introduced, it is possible that the tripod might take the place of wheels, since both gun and tripod can be carried about quickly by the detachment (Fig. 4).

"The great difficulty of working machine-guns with horse and field batteries appears to me to be this: How can you transport them so as to be suitable for rapid movements under service conditions? It comes to this—you must carry them about on carriages and wheels which shall not be less strong than the other carriages of your equipment. No system of carrying them on our already fully weighted gun or ammunition carriages will answer. They must have a separate equipment, and this means an addition to the Officers, men, and horses of your battery. Unless this is conceded, it is hopeless to think of machine-guns as auxiliaries to field artillery."

A Colonel of the Royal Engineers says: "About the tactical employment of the machine-guns I have thought a good deal, and my strong opinion is, that if they are adopted they cannot possibly be attached as an integral part to either cavalry regiments, artillery batteries, or infantry battalions, and that they must either be kept in batteries by themselves (which would be the most satisfactory plan), or else be handed over to the Royal Engineer Companies.

"I cannot conceive their being permanently attached to Cavalry or Artillery without constantly hampering them, as it would only be on rare occasions that they would be required; on these occasions they

would always be available. Until they are made much more formidable than they seem to be at present, I do not see how they can possibly take the place of an escort for Artillery . . . There is a good deal to say in favour of their being in charge of Royal Engineer Companies. They could thus be introduced without an increased establishment, and consequently expense, except for home, as at the times when they would be required for action, sappers would usually be unemployed in the reserve, and could spare the gun detachments necessary to work them. Also it seems to be universally admitted that whatever the value of the machine-gun under other circumstances, it is without doubt specially suited for flanking the ditch of a fort, and for other employment in connection with defensive works, and here there would always be sappers available to work them. I am aware that at times, especially in offensive actions, every sapper is required for his own work at the front, but this work would very generally be the strengthening of a position, village, &c., just carried, and here the machine-gun in the hands of sappers might be invaluable."

Lord Chelmsford writes: "On the advance to the relief of Ekowe, two Gatling guns accompanied the column, and at the battle of Ginginhlovo did considerable execution amongst the Zulus *at the opening of their attack*, which commenced on the north side of our position. The Zulus very soon, however, worked round to the west and south side of our laager, and the Gatlings were not in action therefore for any length of time.

"At Ulundi we also had two Gatlings in the centre of the front face of our square. They jammed several times in the action, but when in work proved a very valuable addition to the strength of our defence on that flank. Machine-guns are, I consider, most valuable weapons for expeditions such as that which we had to undertake in Zululand, where the odds against us must necessarily be great, and where it is necessary to leave small detachments in charge of posts along the line of communications. The Gatlings, however, required too much care in firing, and could not be entrusted to any but skilled manipulators; if a machine-gun can be invented that may safely be entrusted to infantry soldiers to work, and could be fired very much as one grinds an organ, I am satisfied of its great value. They should, however, in my opinion, not be attached to artillery, but should be considered as essentially an infantry weapon, and should be worked by infantry soldiers; so utilized, they might, I feel sure, be used most effectively, not only in defence, but *in covering* the last stage of an infantry *attack* upon a position, where the troops have at last to cease firing and endeavour to get home with the bayonet."

Colonel Methuen, C.B., recently returned from Bechuanaland, telegraphs on morning of 13th November:—"Regret letter only just reached me. I often thought the value two or three machine-guns would have been, concealed in the wagons of a long convoy. In event of fighting I should have had to use your convoy escort, say four troops at some distance from the wagons, and these would have been left unprotected; this would not have been the case had the convoy carried some machine-guns such as you describe."

Colonel Wardrop telegraphed:—"Regret absence from town; am strong advocate for machine-guns; with cavalry quite invaluable; consider must be armament of the future; glad you are ventilating this."

The CHAIRMAN: My lords and gentlemen, I think this subject is one that specially deserves and merits discussion, and I hope there may be a very useful and interesting discussion upon it. I would remind you that the subject is really the uses of machine-guns generally, and that there is no desire, as far as I know, on the part of most of us, to discuss the relative merits of various descriptions of machine-guns. We do not at all wish to go into the question whether the Gardner, the Hotchkiss, or other gun is the best, but to discuss the uses of machine-guns and how they can be best adapted and made use of for tactical purposes in the field.

Lord CHARLES BERESFORD: My lords and gentlemen, it is extremely gratifying to those who take an interest in this question to find an Artillery Officer coming here to put forward the views we have heard this afternoon. There are a few points mentioned in the paper that I should like to touch upon. First of all, as to the question of the single-barrelled Gardner gun; for myself, I think the single-barrelled gun is not so good as the three- or five-barrelled gun, and at the same time it is of almost the same weight as the three- or five-barrelled Nordenfelt. I am not going into the question of which is the best gun, but I think the volley has an important advantage over the single bullet. With an enemy approaching you or in attacking a position that you wish to occupy, it is better to have a volley-firing gun than a single-barrelled gun, and, besides, the volley-firing gun has a horizontal action which does not jamb so easily as the rotary-motion gun. Major West also made a remark as to the question of firing the gun from the limber, saying that it was easy to do it. I entirely agree with him in that proposal, because I always find on board ship that with a little motion we make better practice, especially if the platform the gun is on, is moving; you get your sights on quicker than you do if the ship is stationary. Major West also made a remark as to the question of using these guns against harbours and ships, or on a headland. I entirely agree with him, only I am not quite sure that the shell-gun would not be a better gun, because the shell-gun is an actual and practical range-finder. A small machine-gun like the Hotchkiss, of which they have large supplies in the ships of foreign nations, is a range-finder at a moment, whereas we have nothing of the sort. We have to fire our big guns to get the range. Every artilleryman on shore who is attacking a ship coming in, knows that the great thing is to get the range of the ship as quickly as he can. I therefore think the shell-gun would be better than the rifle-calibre gun for their purpose. Their use for resisting landings and also for landings was very well exemplified by the bombardment of Sfax, which was taken by the French sending their launches and pinnaces with the Hotchkiss 1-lb. shell-gun. They had placed the electric light so that it made two arcs on the shore; the boats advanced on the dark portion of the water; they got close to the town, and Sfax was actually taken with the Hotchkiss shell-gun. We have no gun in our Service that we could have done the same thing with. Major West made a remark about guns being attached to cavalry. Of course for a sailor it would be most impertinent to say what the gun should be attached to. The point I have always advocated is, that the gun is useful. Whether it is mounted on a galloping carriage, so as to be attached to every branch of the Service or to one branch of the Service only, is not for us to say, but what we do say is, that the gun, under many circumstances, is of the most useful character. I should certainly back up what Major West said as to holding streets, because we remember very well that, after the bombardment of Alexandria, a very small force was landed, and it was mainly due to the machine-guns that that force was enabled to clear the town and get things in order. Major West also called attention to the effect of the gun when it was used as described by the Duke of Wurtemberg. We must remember what that gun was and did. It was a very bad gun, it had bad ammunition, was very lumbering, and was treated as a gun, and one of the reasons that this gun has always been objected to by the Royal Artillery is that it is called a

gun, whereas it is not a gun, but merely a cluster of rifles or a single rifle that has the power of what has been described as a company of men in its efficiency and in what it can do. Major West said that he did not care which gun should be brought into the Service as long as the efficiency of the gun was recognized. I certainly agree with him in that. I think our noble Chairman has given his very strong opinion on the question, and the sooner the country will take it up the sooner we shall get an arm which may have a most important future in future wars.

Major-General W. LAURIE: My lords and gentlemen, I had not intended to speak, but as no one else seems desirous to do so I may be allowed to say one or two words, seeing that we had in the North-West rebellion in Canada last spring a little experience of machine-guns. As soon as that rebellion broke out the Minister of Militia, not being able to get any other machine-gun, and not being able to communicate with Admiral Commerell, who has since intimated to me his great desire to have sent a Naval Brigade with us, telegraphed to the States in order to get some of the only guns that were available, namely, the Gatling. I was first of all with General Middleton in the advance, and there I was struck with the desirability of having guns of that description with the advance guard. I really think that the lecturer has not sufficiently emphasised the great importance of machine-guns being employed with infantry, and especially to an advance guard searching the country. The American Officers with whom I came in contact, and who had had experience in frontier warfare, told me that they found the machine-guns most useful, enabling them to stop the column, and to search under brush to the front or flanks, and that the use of these weapons saved a great deal of delay, and also exhaustion to the light troops covering the advance, because a few hundred rounds of Gatling ammunition poured in with a good spread effectually searched any smallwood that was in the way. I must differ from the lecturer on one point, because I believe that what we want is very rapid firing. One Gatling that we had fired 1,200 rounds a minute, but the other Gatling only fired 800 rounds. We had to take what we could get ready made, for we wanted to suppress the rebellion as quickly as possible. I believe that the most rapid firing would be the best. I feel satisfied that a few hundred rounds fired into a copse would clear it of scattered parties of such men as we were likely to come in contact with, such as Indians or other barbarous tribes; they would be sufficiently impressed with 500 or 600 rounds coming in very rapidly amongst them with a fair spread horizontally and vertically, and would clear out, and there would be no necessity to halt the whole column, and send a body of troops for the purpose of turning such a copse as that, thereby delaying the whole advance. I may say that our Gatlings were not used for that purpose because we could not get them up in time. General Middleton was determined to get at his enemy as soon as possible. As soon as I returned to the base and took charge, I pushed forward the Gatlings, but unfortunately he did not receive them during the advance, although they came up in time for some of his fighting. On one occasion it was reported that the Gatling did exceedingly good service in saving a couple of guns of the Canadian Artillery. These guns were being rushed by a party of half-breeds, but the party in charge of the Gatling brought it up and met the attacking party full in the face; so that the Gatling acted as an escort to the artillery and drove back the attacking party, who would probably have captured the gun. But I only give this from hearsay, as I was not present. Of course using the guns in the way that I speak of, to search the country in advance of the column, would necessitate an enormous supply of ammunition, but that point I am satisfied was not sufficiently grasped by those who in the first place ordered our Gatlings, for they gave us only 20,000 rounds, and as soon as I took charge of the base and examined into the quantity of supplies of food and ammunition available, I applied for more Gatling ammunition and was asked in reply, "What do you want with more ammunition? You have 20,000 rounds for two Gatlings." I answered, "Yes, I have just enough for ten minutes' firing, and I should like to have at least enough for a second engagement of that length." It took over a month before we could get an additional 50,000 rounds, but, as the ammunition supplied to the Gatlings was similar to that which our mounted police were using, we were able to fall back upon that to a certain extent. I simply wish to record the experience of the American Officers, because,

going to work as we expected we should have to work, we wanted to get all the information we could about Indian warfare. I therefore lost no chance of hearing from those who could speak from personal knowledge, and they were strongly in favour of the use of machine-guns. I believe they are capable of rendering good service for escort work as the lecturer has told us, but I urge their employment in the way I have stated, although I am aware there will be a large expenditure of ammunition; for even putting aside the strategical advantages of a rapid advance and early arrival at the objective point, and dealing with it simply as a question of transport, my recent experience of the enormous quantity of supplies daily consumed by a marching column, and the difficulties of furnishing those supplies, satisfies me that it is most economical, as a financial and transport question, to expend a few thousand rounds of machine-gun ammunition daily, and thus save a large amount of the wear and tear of flanking and search parties, and delay in the advance of the column, and thus shorten the number of days required to accomplish a march. It is much easier to transport the additional ammunition than the additional provisions for men and forage for horses required for the extra days which the force would take to accomplish the distance if delayed, whilst the country was being searched by infantry.

Admiral ARTHUR: My lords and gentlemen, I must apologize for taking any part in the discussion of this subject, which is chiefly confined to the land services, but after all it is a practical question, and we cannot start any abstract theory upon it. What we want is to know the experience that has been gained in action, and possibly the Navy has handled machine-guns more in action than any other branch of the Service. I wish to support Lord Charles Beresford's view as to the value of the machine-gun as a range-finder, but I must say I do not agree with him in confining it to the shell machine-gun. As a matter of experience I may state that at the last firing I had in the "Hector" we used the machine-gun for that purpose, which, by-the-by, was a four-barrelled Nordenfelt, and we never had better firing from the heavy guns, the range being very accurately given by the man stationed at the Nordenfelt, who was ordered to fire at a slow rate, one shot a minute, and to report the elevation which he used on each occasion; we found by watching the fall of the projectile that we thus got the range within a few yards. The practice of taking an angle at the masthead is very uncertain on account of the want of skill of those stationed there, as you cannot always spare a Lieutenant or an experienced Officer for that purpose; besides, it is very difficult to use a sextant when there is much movement on the ship. The value of a range-finder afloat is incalculable, it will no doubt be also found very valuable on shore, and I do not think that we have as yet got a range-finder so absolutely perfect that the machine-gun might not be found very useful for that purpose.

General SMYTHE, R.A.: My lords and gentlemen, I have only one remark to make, as I have not come prepared to go exhaustively into the matter. I may say that whilst we all admire very much the powers of the machine-gun we must remember all the time the serious difficulties which accompany its action in the open field. As Lord Charles Beresford has correctly described, it represents a cluster of rifles, that is, infantry rifles, and its range is the range of the infantry rifle. To bring it into effective action it must come under the range of the infantry rifle; and the problem is how to get it there against a well-trained infantry. When that problem is solved, no doubt the effect will be wonderful, but at present it is beset with difficulties; and Artillery Officers, who generally set sureness of hitting in the first place, are hardly prepared on such a sudden, and, I might say, with great deference to the lecturer, such a vague recommendation of the effects which he has realized, to accept the novelty of shooting from a carriage passing over rough ground at speed. I have no doubt myself the whole question lies in that, how to get this very powerful cluster of rifles within reach of other rifles which are not so hampered by weight and unhandy machinery.

Colonel MARKHAM, R.A.: My lords and gentlemen, agreeing as I do in every way with what Major West has said as to the value of machine-guns, and with what General Smythe has just remarked, yet I think it is a great question whether you will get accurate shooting moving over rough ground, and also with a machine-gun mounted on a limber; it is a question whether you will obtain accuracy of shooting, because, I believe, the jolting of the carriage would cause so much friction on the

screws and parts of the limber, that eventually there would be a certain amount of play, and the result would be that the guns would have inaccuracy of shooting. I think if the machine-gun is attached to the artillery at all, it should be on a separate carriage. Of course that becomes a matter of expense. I imagine that Major West advocates putting it upon a limber for that very reason, to save expense, but I think you can hardly work the two things together. I think that both the driver of the gun-carriage and the gunners would not quite know which was their proper weapon; the actual gun on the gun-carriage or the machine-gun on the limber; and, therefore, it would be far preferable if it were on a carriage by itself. With regard to attaching the gun-carriage to cavalry, and carrying it in the way proposed by Major West, I did not quite understand how he intended to balance it, and if it were not properly balanced, I think it would be very apt to give the horse a sore back. I would further mention that I do not quite understand the carrying of the ammunition when the machine-gun is attached to the artillery. As the limber-boxes and ammunition-boxes on the wagons of the artillery now stand, I am quite sure they are packed full enough, and it would necessitate additional carriage for the conveyance of the ammunition for the machine-gun.[1]

Major West, in reply, said: With regard to the question as to whether the gun should have one, three, or five barrels, those who have had greater experience than myself are much better able to speak, and the suggestion that we should have very rapid firing for the purpose of searching a copse is a very excellent and practical idea. No doubt the 6-lb. Hotchkiss quick-firing gun would be most invaluable for the purpose of mounting on promontories and the protection of harbours. I do not find fault in any way with that gun, which, indeed, is a very much more powerful machine-gun than any which we have at present. Coming to my own branch of the Service, I do not quite understand why General Smythe said that the machine-gun must come under the range of infantry fire, because there you have a weapon, accurate up to 2,000 yards, which will fire much more accurately than riflemen, because it has no nerves, and it only requires one good man to work it. Of course, if one man comes to grief, you have trained men ready to take his place, and, therefore, I say that it is better than the infantry fire. Then General Smythe speaks of the difficulty of getting it within range. Now if we are always trying how not to do things instead of trying how to do them we shall never arrive at anything, and my idea is that we should open up the question, and then let us come to some trial to see what we can do with it. I say this with the greatest respect, but I do think that we should show some energy in trying to get this question solved in some way or other for the land service, instead of letting it drift on, as it has been drifting for so long a time. The only way to solve the problem is to try to work it out. I am excessively sorry that it should be considered a very "vague novelty," but that is, of course, a matter of opinion and—I say it with the greatest respect—I think it is a great mistake that we should always stick to the old thing when we might get something better. I say distinctly that the machine-gun is not an artillery arm, but it is a powerful auxiliary to the artillery. Colonel Markham speaks of the jolting and the friction that are likely to arise. No doubt that is so; but then we must look to all these things. If a thing gets out of order by jolting and friction and that sort of thing, we must see to it; let the wheeler[2] examine the adaptation every day after drill the same as he would examine the gun-carriage. Do not let us give up the whole thing simply because some little difficulties arise, but let us do something and try and make something out of it. Then

---

[1] I would add that Major West has not described how the machine-gun, packed to accompany cavalry, was to be brought into action. It is presumed the horse would be led, and a certain number of men told off to dismount and work the gun; but it appears to me that this would be a longer business and less practicable than conveying the machine-gun into action on a carriage specially adapted for it, which would also convey the ammunition. As the machine-gun would be chiefly used for defensive purposes, it is a necessity that it should be arranged to be quickly brought into action and also out of action, and I conceive that this could not be rapidly done if carried on a pack-saddle as proposed by the lecturer.

[2] Each battery of field or horse artillery has such an artificer called a wheeler.

as to inaccuracy, no doubt there will be inaccuracy to a certain extent, but I say that instead of the guns being utterly helpless when limbered up, they will be able to show what they can do if they have these machine-guns to assist them. Let us try it on rough ground; there is no reason why it should not be tried; let us jolt and gallop and knock it about all over the place, but do let us give it a trial. Then with regard to not being able to do any shooting, why it is to be said that we could not do it off a limber when sailors do it off a ship and fire at another moving object, I do not see at all. As to the men not knowing which gun is their gun, the time when it would be chiefly used with artillery would be when the Gardner gun was supplementing shrapnel fire, or when the gun was on the move, and I do not see what difficulty there could be about that. With regard to the question of balance, when the gun is carried on horseback, of course I have only shown you the very roughest adaptation. I had the horses unhooked outside; the shaft-horse was merely taken out of the gun-carriage, the back-band was taken up a little, the muzzle of the barrel put through the loop of shafting on near side, and then run right up to the chamber, while the loop where the shaft goes on the off side was slipped over the pedestal or socket. One strap went round the long leg, bound the three legs together by their own weight, tightening up on it, and went across to the muzzle of the gun on the near shoulder; then there was one from the off quarter to the near shoulder, and these straps acted as stays. As to the sore backs, there were sore backs, but it is a thing that must be properly adjusted and tried. As to the balance, I had the thing weighed, and there is a difference of about 8 lbs.; but I say that this is the very roughest adaptation, and if people would set to work and try to make something out of it, I think they could do it. A very simple pack-saddle could be made, and then there would be no sore backs. I can see no difficulty whatever about it if you have a pack-saddle. As to the ammunition, my suggestion was that a thousand rounds could be carried without difficulty on the foot-board of the limber. Of course allowance must be made for reserve, but a thousand rounds with each limber would be worth something. I repeat that my adaptation is of the very roughest kind, and that I do not believe that the difficulties that have been mentioned are at all insuperable.

The CHAIRMAN: I am much disapointed, and I am sure most of those who came here to-day are disappointed, that the discussion has not ranged further on this subject, and that so few Officers have taken part in it. It is a subject, I think, especially for discussion, because the English Army has now most certainly arrived at the conclusion that we must have machine-guns, and I am very glad to say the authorities have at last decided upon their being introduced into the Army. But although I think it is to be much deplored that we have not had a fuller discussion upon the tactical merits of machine-guns in the field, still there are some points, I think, that we may congratulate ourselves upon with regard to this meeting to-day, and one is the fact of this subject having been brought before the Institution by an Officer of the Artillery. That I consider really a very great point to gain. I should be very sorry to say that any branch of the Service has particularly opposed or been obstructive to the introduction of machine-guns into the Army, but there certainly is a very common impression in the minds of a great number, that opposition from Woolwich has prevented our having in the Army any machine-guns for many years past. I am very glad to congratulate my friend Major West on having taken this subject up, and having come forward as an Artillery Officer to give us the benefit of his opinions upon it. I think also those present to-day are to be congratulated upon the fact of the presence here of Lord Charles Beresford, who has had more experience with these guns than most of us, and who is one of the very few Officers who has actually used machine-guns in the face of most serious attacks in the field made by an enemy charging home, not an ordinary charge of people coming up to you, but a determined enemy charging home into your square. I have no intention in his presence of at all repeating the story that has been so frequently told of how he at a most critical moment made use of machine-guns to such advantage as he did upon the return of those vessels from Khartoum, when I may say it was the machine-guns he had in his possession on board that day that enabled Sir Charles Wilson's party to come back in safety. I think I am justified in saying that had it not been for the machine-guns he had with him, the ship he

was on board of must have been wrecked, and most probably all on board killed or taken prisoners. It was simply, to use his own expression, by "pumping lead" into the embrasures from which the guns of the enemy were pointed against the ship that he was enabled to prevent their manning those guns, or of even running them out to fire them. One of the first questions discussed was the point of how many barrels there should be to these guns. I think it makes very little matter. Experience will tell us most probably which is the best. I rather agree with Lord Charles Beresford that they ought to have more than one barrel. I think the reason I should recommend more than one is, that in case one barrel got hot in firing, or that any accident occurred to it, or to its firing action, it would be a very good thing to have a second or a third barrel in reserve. I think that, quite apart from the advantage of being able to fire volleys from guns with several barrels, I should be afraid to rely entirely upon a single barrel. The use of machine-guns is really in its infancy, and as yet we have only used them upon a few occasions, Lord Chelmsford used machine-guns at Ulundi, and we have recently used them in the Soudan. However, whenever we have used them, we have thoroughly realized the advantages they give. We have recognized the necessity of having them with the army in the field, and by degrees when we have really decided upon the best equipment for them, we shall after a little experience over all sorts of ground be able to arrive not only at the best means of equipping them and carrying them in the field, and also of carrying their ammunition, but we shall then be able to decide how they can be best tactically made use of in action. As regards the range, General Smythe has referred to the almost impossibility of using machine-guns under infantry fire, and he has spoken of infantry fire as if it must necessarily be the limit within which you can use machine-guns. I do not quite agree with him there, because I do not attach such enormous importance to the very long range infantry fire from the shoulder, it must be always very inaccurate. But I feel convinced the fire of this small arm—because it is not a gun, it is a small arm, an infantry arm, it is not an artillery arm—I think the fire of this small arm, firing from a fixed carriage at ascertained ranges of 2,000 up to 3,000 yards and beyond, will be most effective. You have only to ascertain your range, and I hope we shall be able to do so by means of good range-finders, and then I believe you will render it almost impossible for any field artillery, offering as it does such a very large mark, to live under the amount of lead that can be poured upon any particular portion of ground that may be occupied by any arm of the Service. Of course the use of machine-guns from which a constant fire is to be maintained, whilst they are in motion over rough ground, presents a great difficulty, but for myself I attach importance to this weapon, not for the purpose for which the lecturer has brought it forward so much as for use with the infantry arm. I believe myself, as I have said before on a previous occasion in this hall, that the machine-gun has an immense future before it; that when intelligently made use of by an able commander in the field, its effect will be almost incalculable, and will revolutionize, according to my view of the question, our tactics generally. But using it from a fixed carriage whilst stationary is of course a very different thing from using it over rough ground on an artillery carriage when in motion, in the manner proposed by the lecturer. At the same time, I think there is not an Officer present who can look back to the various military campaigns he has read of, without remembering some instances where artillery, limbered up on the march and therefore quite defenceless, have not been taken by cavalry. Now had that artillery when charged in a hollow road, in the open, or in a wood, had one, two, or three of their carriages armed with machine-guns in the manner the lecturer has proposed, I think there is very little doubt that the cavalry would have been beaten off. Major West quoted Colonel Methuen about his experience with large convoys in South Africa. My knowledge of that country leads me to the same opinion, that if on every fiftieth or hundredth wagon you had a gun mounted as now proposed, no cavalry could approach them. The wagons so armed would in fact be a series of moving martello towers, and although the firing might not be so accurate as to hit a horse at 1,000 yards, still it would keep off cavalry, and no cavalry would charge home in the face of such a fire. I do not find there is any other point in the lecture that I have noted to remark on. I wish I had, through a wider discussion of the subject to-day, a wider field for my remarks, but

D 2

I am sure you will all agree with me in saying that we have been very much interested in the lecture, and that we are all very grateful to Major West for having brought this subject before us.

Mr. NORDENFELT, being called upon by the Chairman to explain his gun, said: My object in making a single-barrel gun was to see how light a machine-gun could be made that could fire quickly, and I believe this is as light as a gun could be made. I believe it is, if anything, too light. In order to fire 180 rounds a minute from one barrel, you want a mechanism which will act reliably. The feed is the ordinary feed, the same as for the many-barrelled gun.

The CHAIRMAN: What is the weight?

Mr. NORDENFELT: It is 13 lbs. without the shoulder-piece; about 15 lbs. altogether. But I am afraid I cannot advocate a single-barrelled gun; I do not like it. I am under the impression that it is a great advantage to have more than one barrel. If you can make a gun within the computable weight for the purposes for which you require it, the more barrels you get into the gun the better. I do not know if I am out of order if I ask to be allowed to say a few words about the ammunition. One is carried away rather with the idea that if a gun fires 1,200 rounds a minute, you want 20,000 or 30,000 rounds actually on the spot. You want the ammunition very near you, but I do not think you want a very large quantity actually in front, because if a machine-gun has fired effectually a few hundred rounds into a copse, I think it has done its work for that minute. Although you may fire 1,200 rounds a minute at a fixed target at the very short range of 100 yards, I know that with the five-barrelled guns of any pattern we never get more than 170 rounds a minute aiming at a moving target. In the same way with the one-barrelled gun, instead of firing from 200 to 300 rounds, you only fire 50 or 60 rounds a minute aiming, and that I think is rather too little for the purpose of machine-guns. I am under the impression that you ought to be able to fire in a few minutes a tremendous number of rounds under given circumstances, and then you would move your gun and wait for a few minutes when the first firing had produced the desired effect. The mechanism of the gun is tolerably simple, and I believe that any single-barrelled gun would be very useful under certain circumstances where you are limited to very low weight indeed. But, as I have said, if you can get more barrels in the same weight, it is better. It is an advantage to be able to fire a volley: for instance, supposing cavalry suddenly come up to you turning round a corner or up a passage, you must aim now and then, and if you can fire volleys between aiming, you can discharge a greater number of shots than you would if you fired single shots between the aims. I am especially pleased that Major West, as an artilleryman, has taken up this subject, and I hope it will lead to what I consider most important to have, further experiments with machine-guns mounted in every possible way.

Friday, January 22, 1886.

Captain the Right Hon. Lord CHARLES D. BERESFORD, C.B., R.N., M.P., in the Chair.

MACHINE-GUNS, THEIR USE AND ABUSE.

By Captain R. H. Armit, 22nd Middlesex Rifle Volunteers, Central London Rangers (late Lieutenant Royal Navy).

The Chairman: Gentlemen, I have the pleasure to introduce to you Captain Armit, of the 22nd Middlesex (London Rangers) Rifle Volunteers, who will read a paper on "Machine-guns, their Use and Abuse." The paper will be more interesting because Captain Armit and his Colonel, Colonel Alt, were the first two who have ever tried practically to use a machine-gun for drill purposes to show how it would be used in the field; in other words, they tried the first mounting for it. The paper I think from that circumstance will be very interesting to all present.

Captain Armit: My lord and gentlemen, as a retired naval Officer, upon joining the Volunteers I used my best endeavours to make our corps efficient, and with the support of my Colonel I have introduced into the Volunteers these guns. We have had experience of them for over four years, and before the war broke out in the Soudan we were enabled to point out, that which was ascertained in that war by practical experience, that the rifle-calibre machine-gun was valueless when mounted as a field-piece. It is to Colonel Alt that the credit is due of taking the lead in mounting machine-guns on magazine carriages; in fact, only this day the Director of Naval Ordnance was kind enough to inform me that that was the fact. Having studied this question ever since the war of 1870, when I was in the field with the German forces, I have taken the liberty of writing this paper, which I hope you will allow me to read, with that indulgence which you always accord to novices in this line.

The adoption of machine-guns for military purposes has been much delayed by the absence of knowledge obtaining in regard to their use and capabilities. The failure of the Montigny, the first mitrailleuse used in warfare, so prejudiced the minds of soldiers against this arm, that notwithstanding the many improvements since introduced into this system of firearms, the military authorities of all nations have looked upon it with distrust up to the present time. The Gatling was invented before the Montigny, but only a few of these guns were used by the French during the latter part of the Franco-German war. They were about the same time introduced into our Navy, where they gave but little satisfaction. The Montigny mitrailleuse followed directly *after* the Gatling as follows: The Gatling having been invented and first tested during the American Civil War, was exhibited in the Paris International Exhibition of 1867, where Napoleon III took a great fancy to it, and ordered field tests with it. As it was then in an unperfected state, with a speed of fire of only 60 to 100 shots a minute, the French Commission made a semi-favourable

report. That is, they predicted a great future for machine-guns, and urged the necessity of immediate development, but condemned the Gatling as it existed. Since then other systems have been invented, and various types of those systems have been brought to the notice of the public. But to this day, so little is really known, both in and out of the Services, concerning the actual development of mechanically loaded and fired ordnance, that whatever the system or type used, they are generally designated as Gatlings or machine-guns.

Much uncertainty exists as to the real meaning of the term "machine-gun." It is applied to a magazine-rifle, a mitrailleuse, and a shell-firing piece of ordnance, without the slightest distinction. Nor does it appear to matter whether the arm spoken of has one or more barrels. Every description of firearm not actually reloaded by hand by the firer, that is to say, mechanically loaded arms not as yet used or recognized as belonging to field artillery, are now termed machine-guns. This is not only a grave mistake, but it also leads to false impressions being formed as to the relative value of the different types of machine-guns now competing for adoption in the Service. In the Army, nine-tenths of the Officers and men only know this arm, whatever its type may be, by the name of Gatling, the pioneer of all these guns. Few, very few, understand the mechanism of any of the types of which the Gatling is the generic system. It is therefore necessary, when dealing with this important question, to class machine-guns not only according to their types, but also according to the system they form part of. Nor should their tactical value and strategical importance be overlooked. Of the relative value of machine-guns, which are merely different types of the same mechanical system, little would need to be said (as they all use the same barrels and cartridges, and their performance must consequently be approximately the same) were it not for the fact that certain tests which, on but very slight reflection, must appear to all sensible men as utterly unfair, have been adopted to determine their relative efficiency. No man in his senses would now advocate the trial of the Enfield-Martini or infantry rifle against field artillery, with a view to deciding whether the Army shall in future be armed solely with rifles or guns. And yet, the machine-gun of rifle-calibre has been so treated in Russia, and the "Armeeblatt" has actually published a report that a Mitrailleuse-Nordenfelt has beaten the cannon-revolver Hotchkiss! But to speak of a machine-gun of rifle calibre as having established its actual superiority over a revolving cannon, firing explosive shells weighing 3 lbs., or other light ordnance of this rapid-firing type, is simply absurd. That there may, at times, under certain well-defined conditions, be a relative superiority in the lighter over the heavier of these guns, we know to be the case. Thus, for example, in defending a breach, a ravine, a bridge, or a road, the mitrailleuse is relatively superior to the shell-firing gun at close quarters, owing to the large number of rifle bullets it can fire in a short space of time. At close quarters this is a decided advantage, provided the guns are not put out of action by the chamber of one or more barrels being choked or jambed by unextracted cartridge-cases or from other

causes. This happened at Ulundi, El Teb, Tamaai, and Abu Klea. It has never happened with the larger shell-firing guns in such manner as to be a real source of danger to the gun, while a single unextracted cartridge-case will so choke the chamber of a Nordenfelt, Gardner, or Gatling rifle-calibre gun, as to render it impossible to clear the jamb for many minutes, during which time the guns, if in action, are liable to capture.

It was in the early part of 1880 that the Committee presided over by Admiral Boys commenced experimenting with machine-guns at Shoeburyness.[1] I called at that time on General Sir Frederick Campbell at the War Office to obtain leave to attend those experiments. Sir Frederick granted my request, but before dismissing me, took the opportunity of imparting to me his views on the machine-gun question. In Sir Frederick Campbell's opinion, twelve riflemen could deliver a more telling fire than any machine-gun, and yet every such gun would require more than twelve men to work it. The Gatling had proved a failure; there was no reason to suppose that the Nordenfelt could do better; in Sir Frederick Campbell's opinion, the only machine-gun of any real utility was the Gardner. This, he thought, I would find correct on visiting Shoeburyness. Above all, I was to remember that the British Army was using Boxer cartridges, and that guns not adapted to fire those cartridges could not be of any use in the British Service. At Shoeburyness I found the experiments went entirely in favour of the Nordenfelt mitrailleuse; that although the different types competing could be made to fire Boxer cartridges, it was courting accident to use these soft, copper foil and paper cases, in mechanically loaded arms having such a great rapidity of fire. Nor could I understand the utility of retaining the Boxer cartridge in use in our Service, when all foreign nations had already adopted the solid-drawn brass-cased cartridge, and I discussed this question in several articles which at that time appeared in the columns of the press. The authorities reconsidered the question, and announced that the Boxer cartridge should be done away with, and I believe it will be in time.

The Committee reported in favour of the Gardner, and the War Office would supply no other gun, so a certain number of these were issued to the Navy, and were worked side by side with the Nordenfelt four-barrel one-inch gun; the old Gatling—the pioneer of these weapons—having by this time been condemned. But the Nordenfelt action was better liked afloat than the rotary action of the Gardner, the horizontal lever enabling better shooting to be made, and as constant complaints reached the Admiralty of the uncertain working of the Gardner, their Lordships purchased some five-barrel Nordenfelt guns of rifle calibre on trial. In all this the Admiralty have had but one object in view, namely, to supply the Navy with the best arm that it is possible to procure, and I am assured on the highest authority that were the Navy to report to-morrow in favour of any other system or type as superior to those in use, that new

[1] Some statements which appeared in the paper as read have been withdrawn by the author.—Ed.

system or type would be forthwith adopted, and not another gun of the old types would again be purchased, for "it is the Navy who will have to use these guns in action," recently remarked the Director of Naval Ordnance, "and it is, therefore, my intention to let the Navy select that weapon it can use to the best advantage." This is, in my opinion, the right policy to adopt with regard to the Navy. I would even go a step further, and dissociate the Admiralty from the War Office, leaving each Department to provide ordnance for its own branch of the Service. In my humble opinion, until we do this, the Navy will never be properly armed, and at the present moment our first line of defence has only the War Office to thank for the endless variety of guns now in use in the Service, causing each ship to carry many different kinds of ammunition, and each ship's company to learn so many different drills, that proficiency is impossible, and accidents often take place. Indeed, but for the wonderful discipline and organization that obtain on board every one of Her Majesty's ships, accidents would be of more frequent occurrence than they are.

In the Army machine-guns are only now being introduced. The military authorities, having but recently recognized the value of these guns for work in the field, have ordered seventy-five Gardner guns wherewith to carry out tactical experiments at Aldershot. Of these, fifty are two-barrelled guns, each weighing as much as the Nordenfelt five-barrelled gun, while twenty-five are five-barrelled guns, each weighing as much as the Nordenfelt ten-barrelled gun. The questions of mobility and efficiency have thus been ignored, and instead of adopting the wise policy of the Admiralty of enabling the Service to decide for itself which system and type is the most useful, the military authorities have strictly adhered to the recommendation of the now old and obsolete Machine-gun Committee Report, evidently forgetting that during the last five years, not only have improvements been made in the systems tried at Shoeburyness, but that an entirely new system—the Maxim—has made its appearance, and claims a trial.

Nor should it be forgotten that while we have been wasting much valuable time in discussing the relative merits of the various types of the different systems of rifle-calibre machine-guns now before the public, the leading military Powers of Europe have condemned them one and all, preferring to arm their infantry with magazine-rifles, and to adopt shell-firing machine-guns for other purposes in the field, and for the flank defence of fortresses. Hence I am of opinion that the tactical experiments about to be carried out at Aldershot will lead to most imperfect results, should but one type of the machine-gun be employed, and that, too, a type that has already proved itself most unreliable in action. Our military authorities are no doubt actuated by a real desire to solve this important question, but to carry out this desire, they should break free from the trammels of the Ordnance Department, and allow the dictates of sound practical common sense to govern their action in this matter. The magazine-rifle should be tried at the same time as the rifle-calibre machine-gun, while the shell-firing machine-guns of two, three, and six pounds should also

find a place in tactical experiments, from which the revolving cannon should not be absent, should it be desired to obtain definite results of all these new arms, and Officers and men set to work them should have the opportunity afforded them of ascertaining for themselves which type of each system they can work to the greatest advantage, and which system above all others they prefer. Personally I advocate neither type nor system, but I deprecate the recommendations contained in the Report of the ancient Machine-gun Committee being acted upon after so many years have elapsed since those recommendations were formulated, years during which the whole science of modern warfare has been made to undergo so many changes.

We have been educating men to believe themselves invincible because of the superiority of their arms, forgetting that when those scientific toys fail them, the men are powerless. Men should be taught to depend on their own individual strength, pluck, and prowess, and not in any single weapon.

It was through the abuse of the use of machine-guns that the French lost many a position during the Franco-German war. The Emperor Napoleon imagined that in the Montigny he possessed an arm so simple, and yet capable of creating such fearful havoc in the ranks of the enemy, that its use would of itself insure victory to his army. Hence, long before the declaration of war against Prussia in July, 1870, the manufacture of the Montigny proceeded briskly in all the French arsenals. The guns, when made, were mounted as field-pieces on trail and limber carriages; the latter were filled with cases of ammunition, and all were carefully stored away and kept under lock and key. Not a soul was allowed to go near them. No drill was compiled for their use. And it was not until the day that war was declared that these guns were issued to the French Army. Then teams of artillery and train-horses, ready harnessed, were sent down with their drivers and improvised detachments, to the stores in which the mitrailleuse had been kept. The horses were hooked on, and thus battery after battery was marched off to the German frontier to join the Army of the Rhine. But, at Spicheren, at Wörth, at Gortz, and Mars-la-Tour, at Gravelotte, at Beaumont, and at Sedan, whenever a French General relied on these guns to enable him to hold a position, he was doomed to be most bitterly disappointed. In numerous cases which came under my own observation whole batteries of the French Montigny guns were captured before they had been able to fire a single round. In other instances, but a few rounds were fired before the gun jambed in such a manner that the untrained detachments were unable to clear them before the Germans were upon them. The last shot had not long been fired on the field of Sedan, when General Sir Henry Havelock-Allan, V.C., rode up to the Balan Gate of that fortified town under escort of a troop of Bavarian dragoons, and obtained admission under the white flag and red cross of the Geneva Convention. I accompanied Sir Henry, and I shall never forget the sight as we threaded our way through the narrow streets of Sedan, crowded with the living, the dying and the dead, to the mairie in which the Emperor of the

French had taken up his quarters. While conversing with various members of General McMahon's staff, and later on in the square of the town where stood the single mitrailleuse battery saved from that day's fight, ample evidence was afforded me of the disastrous consequences that can follow on the abuse of the use of such a weapon in the field.

I spoke to the old battery sergeant-major, a man wearing the English and Turkish Crimean medals. He informed me that not a man of his battery knew how to load or work the guns when they were served out to them. He had first to teach himself, and after each day's march endeavoured to instruct his men, or at least as many of them as were willing to devote some of their spare time to learning the use of the arm they were detailed to fight. "But, sir," he said, "that cannot be done in a day, and no wonder we have been beaten with such a disgraceful organization as ours." This old soldier was very severe in his remarks on the practice of sending untrained men into action to fight with an arm they knew absolutely nothing about.

I subsequently went among the French prisoners, and examined the Montigny guns captured by the Germans. One batch were still close to the position they had held during the battle. From these I learnt as follows:—"We were posted on that ridge over there. The Germans had to come up this steep incline, which our guns were supposed to sweep, and we were to hold the position at all hazards, so as to prevent the flank being turned. When the Germans appeared, we were ordered to reserve our fire until the enemy were within 500 paces. On came the Germans in three lines as steady as a rock. They opened fire, and many of our comrades fell before we got the order to load. This was not easily accomplished. The cartridges, the breech action, everything stuck. At last we were ready, and the order to open fire was given. We believed in our guns, and expected to see them sweep the hillside clear. But after the first salvo the difficulty was to reload. One gun here and there could be heard by its rattle, but the delay was fatal; a few moments more and the Germans were upon us, the guns were captured, and we were prisoners."

If we now turn to the Soudan, we find that the Gardner and Gatling guns worked by our Naval Brigade, men who certainly had the advantage of previous training, did not answer much better. Our guns were also mounted on trail and limber. The limbers, containing the supply of ammunition, were cut off from the guns, and the latter jambed at the critical moment, whereby the lives of the Officers and men who so gallantly fought them were sacrificed. At El Teb, Tamaai, and Abu Klea, and previously at Ulundi, both Gardners and Gatlings failed us at the critical moment of the fight.

I recently asked one of the men present on three of these occasions what he thought of machine-guns. His answer was, "Not much, for when you want them to speak they are dumb." It is in this manner that a most useful weapon gets a bad name, and from the moment that is the case it is very difficult for it to retrieve its reputation.

From the foregoing it is evident that the following conclusions may

be drawn:—(1) That machine-guns, whether of rifle or heavier calibre, should always be worked by trained men; (2) that the men forming the machine-gun detachment should be armed in such a manner as to be able of themselves to defend their gun if anything should go wrong with it, and the enemy come to close quarters; (3) that the gun must never be separated from its ammunition; (4) that in the field the machine-gun should be recognized as having just as distinct a tactical position as cavalry, artillery, or infantry, and that it should never, if possible, be made to do work for which it is not fitted.

It will be readily admitted that the infantry rifle and the field-piece have totally distinct functions to perform on military service; and, although each may in many cases be devoted to the duties of the other, and even fulfil them to a certain extent, the line of demarcation between them is, and from the very nature of the manner in which each is used must be, distinct. Both the rifle and the field-piece are necessary in the military armaments of civilized nations, for neither can replace the other, and the army—all things being equal—that took the field minus the one or the other would assuredly be beaten by an opponent possessing both, as the necessities of service in the field are as great for the one as for the other. But the position of machine-guns in the field has as yet to be determined. Speaking in general terms, the machine-gun of rifle calibre may be regarded as an auxiliary of the infantry, both in the field and in the defence of fixed positions and fortresses. The shell-firing machine-gun, of all calibres, should, however, be looked upon as field artillery; and, whereas the former may be worked by the infantry, by means of men specially trained for the purpose, the latter should be handed over to the artillery, to be organized and worked as a special branch of the corps, until the modern field-piece is done away with, and the quick-firing shell-gun has been adopted in its stead, as will assuredly be the case one of these days, now that the question of recoil has been solved in both the Maxim and the Hotchkiss systems, by utilizing in the Maxim system the power generated by the recoil of the barrel to load and fire the gun, or by taking it up on a non-recoil carriage, as in Lieutenant Verey's development of the Hotchkiss system. However, the day is far distant when this dream of the artillerist will be realized, and at least one great European war may have to be fought without the aid of such non-recoiling artillery. It would, therefore, be the height of folly on the part of a nation to refuse to arm itself with the quick-firing guns now at its disposal, on the plea that in a few years' time they will be obsolete; for no nation can rely solely on her rifles and muzzle- or breech-loading field-pieces when her neighbours are supplying themselves with machine-guns of rifle calibre, as well as with those constructed to fire explosive shell. All must keep pace with the times. In the present complicated state of affairs in Eastern Europe, there is no telling when the nations interested in the reversionary interest of the Sick Man may not fly at each other's throats, in the belief that one or the other is trying to obtain more than his fair share of the plunder. This has long been understood. The danger has been foreseen. The nations interested

have been forewarned. Hence, we may assume that when the struggle commences, we shall find them all forearmed. Shall England wait? If so, she will assuredly find herself left out in the cold when the division of profits commences. But to continue. The term "machine-gun" is generally misunderstood, and is always accepted in its generic sense. It is made to apply at random to machine or magazine rifles, machine-guns of one or more barrels of rifle calibre, up to 1-inch calibre, and to shell-firing guns. Hence it is obvious that the relative positions of the various systems of machine-guns should be clearly understood before attempting to go a step farther. These may thus be classified—the revolving barrels, the stationary barrels, and the recoil barrel. These systems must be classed as follows:—

1. The bullet-firing gun, or mitrailleuse, ranging in calibre from 0·35 to 1 inch. This type is more closely allied to the infantry rifle than to the field-piece of the artillery.

2. The shell-firing gun, ranging in calibre from 1·45 to 2 inches and more. This type is more closely allied to the field-piece of the artillery than to the rifle of the infantry.

No one would think for a moment of organizing trials to ascertain the relative value of infantry and field artillery fire, with a view of only retaining in use that arm giving the better results of the two! And yet that is what we have been doing with machine-guns. Surely, it stands to reason that, to appropriate any of these guns for work in the field for which they are specially adapted, is to make a right and proper use of a valuable invention; while to set guns of rifle calibre to perform work that shells alone can successfully accomplish, is an abuse of an arm that might lead to ultimate disaster. But, by far the greatest abuse of the use of machine-guns it is possible to make is to set men to work them who have had no training in their manipulation. The men set to work machine-guns should be as intimately acquainted with the working of every part of the mechanism of these guns as a surgeon is with the anatomy of the human body. And just as the latter can tell by his patient's pulse what is wrong with his anatomical system, so should the man working a machine-gun be able to tell instantaneously, by the feel of the throb or jerk of the firing lever in his hand, what has gone wrong with the internal mechanism of his piece, and at once be in a position to clear the action without the use of force, thus avoiding accidents, while at once bringing his gun back into action.

Five years ago I joined the Volunteers. At that time machine-guns had only been used in this country by the Navy. But it was evident that the great improvements introduced in the mitrailleuse would at no distant date cause it to be an important factor in all military operations. Lieutenant-Colonel Alt, commanding the Central London Rangers, came to the conclusion that this arm was particularly adapted to that very species of work that our Volunteers may be called upon to perform, such as repelling landing parties on a coast, defending fixed positions, mountain passes, roads, and bridges, and it was determined to obtain the sanction of the authorities for two rifle-calibre machine-guns to be added to the establishment of the

uggle
wait?
n the
chine-
n its
azine
-inch
ative
learly
thus
l the

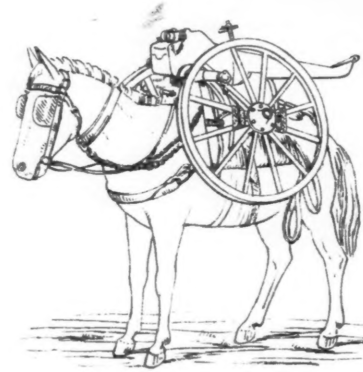
from
rifle

s and
f the

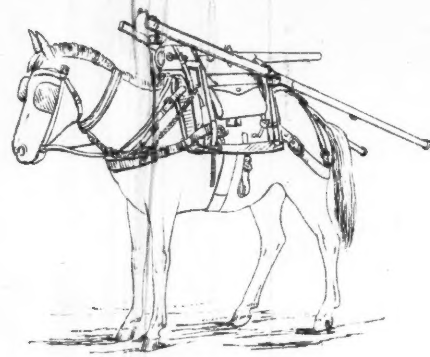
rtain
ew of
two!
urely,
ork in
t and
alibre
is an
r the
is to
ation.
inted
s as a
s the
mical
o tell
ver in
f his
e use
back

hine-
t was
leuse
or in
the
was
ateers
s on a
dges,
r two
f the

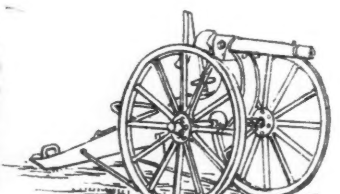
QUICK FIRING MACH



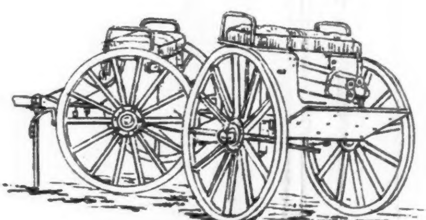
CARRIAGE ON MULE.



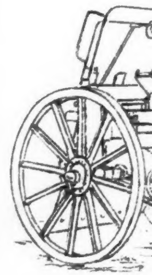
GUN ON MULE.



HOTCHKISS 1-PDR. QUICK-FIRING
SHELL-GUN WITH SHOULDER-PIECE.

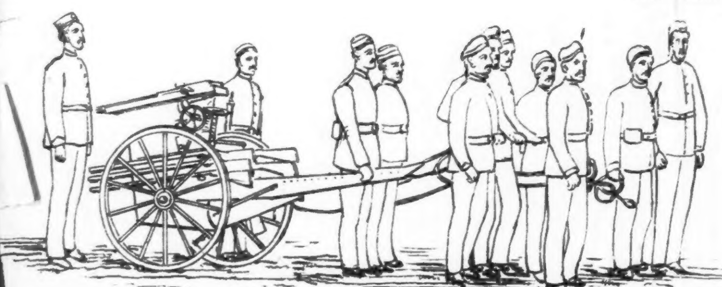


HOTCHKISS REVOLVING CANNON MOUNTED AS A
FIELD GUN.

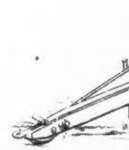


HOTCHKISS F

NORDENFELT 0·45 GUN MOUNTED

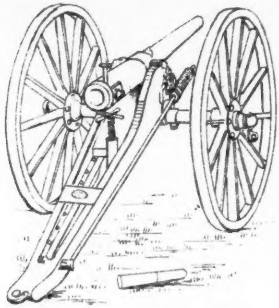


A GUN OF THE CENTRAL LONDON RANGERS ON THE MARCH, DRAWN BY A DETACHMENT OF 10 MEN, OF WHOM
4 ARE ON THE TRAIL, 4 ON THE DRAG ROPES, AND THE 2 NON-COMMISSIONED OFFICERS IN REAR.

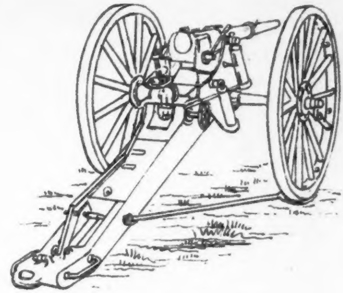


THE ALT MACHINE GUN MAGA
5,000 ROUNDS OF AMM

ING MACHINE SHELL GUNS.

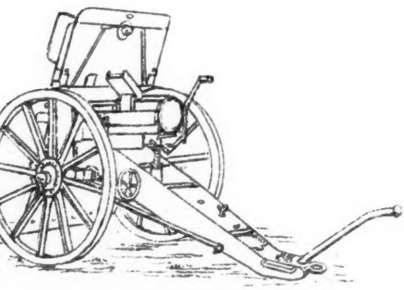


HOTCHKISS 2-PDR. GUN IN ACTION.

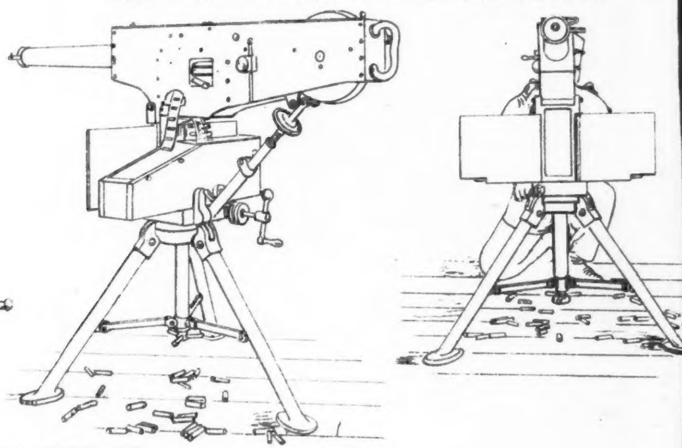


HOTCHKISS 6-PDR. QUICK-FIRING SHELL-GUN ON NON-RECOIL CARRIAGE.

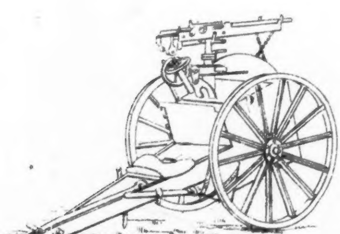
THE MAXIM AUTOMATIC RIFLE CALIBRE GUN.



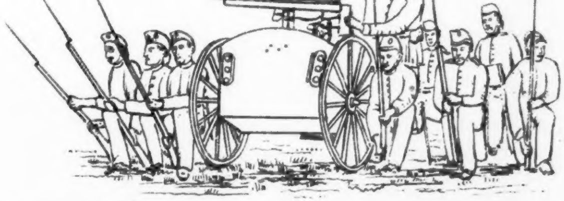
HOTCHKISS REVOLVING CANNON IN ACTION.



MOUNTED ON COLONEL ALT'S FIELD CARRIAGE.



MACHINE GUN MAGAZINE CARRIAGE CONSTRUCTED TO CARRY
00 ROUNDS OF AMMUNITION. TOTAL WEIGHT 10 CWT.



RIFLE CALIBRE NORDENFELT MOUNTED ON LIEUT.-COLONEL ALT'S MAGAZINE CARRIAGE, CONSTRUCTED TO CARRY 5,000 ROUNDS OF BALL CARTRIDGE, THE GUN AND CARRIAGE COMPLETE WEIGHING 10 CWT., INCLUDING THE BULLET-PROOF SHIELD SEEN ON THE BREAST OF THE CARRIAGE BETWEEN THE WHEELS. POSITION OF DETACHMENT, TO RESIST CAVALRY.

Harrison & Sons Lith. St Martins Lane W.C.

I.

reg
ne
ord
ob
the
Ce
ba
we
fou
cal
had
lim
ing
wh
ma
gu
pos
dir
C
cal
ma
jun
des
The
two
mea
thi
or
are
by
the
lim
with
10 c
H
to
com
dril
Ran
100
who
but
less
sold
wer
trai
dan
than
is n
num

regiment. The first thing we did was to procure the guns. The next to ask leave to be allowed to use them. Had we reversed the order of things, the probabilities are that we should never have obtained the guns, but as matters stood, having them we demonstrated the possibility of using them in conjunction with infantry. The Central London Rangers (22nd Middlesex R.V.) was the first infantry battalion to use the machine-gun in any form. At first our guns were mounted like field-pieces, with trail and limber; but we soon found that in close infantry formations this way of mounting rifle-calibre machine-guns rendered them useless. For whenever the guns had to be brought into action, they first had to be reversed, and the limber taken to the rear, the ground covered by the operation rendering it impossible to work them in close formations. Then, again, when required to advance it was necessary to limber up. In this manner delay arose, while should square have to be formed, and the guns brought into the angles, reversing them to get them into position scattered the wheeling half-companies or sections in all directions.

Colonel Alt was thus enabled to arrive at the conclusion that rifle-calibre machine-guns would have to be worked from a limber or magazine carriage; and having explained to me his views, I, in conjunction with Mr. Nordenfelt, from whom we had obtained our guns, designed in 1884, for Colonel Alt, the carriages we now have in use. The Alt machine gun-carriage is a combination of limber and trail on two wheels. The limber forms a magazine, protected in front by means of a Cammell compound armour plate, about half an inch in thickness, through which no rifle bullet can penetrate. The limber or magazine carries 5,000 rounds of ball cartridge, and on either side are racks for the rifles of the gun detachment. The trail is supported by four men when on the march, the drag-ropes being hooked on to the axles, as in the naval field-piece. The gun is mounted on the limber between the wheels, and can be trained through an arc of 180° without moving the trail. Gun, carriage, and ammunition only weigh 10 cwt.

Having obtained the guns, the next thing to do was to train men to work them, and Colonel Alt having placed the guns under my command I proceeded to compile a drill from our old naval field-piece drill. Volunteers were not wanting from the rank and file of the Rangers to man our machine-guns, and in three months we had over 100 men trained to their use. Taking a detachment composed of men who had made themselves efficient in the ordinary sense of the term, but who had never seen a machine-gun before, men who, nevertheless, were steady drills in the ranks, good shots, and intelligent soldiers, I found that, although they could handle their rifles, they were utterly useless when set to work a machine-gun without previous training. In fact, the machine-gun in their hands became a source of danger to themselves and their comrades, more so indeed to the latter than to the enemy. For example, to work a machine-gun properly it is necessary that the various duties should be allotted amongst the gun numbers in the same manner as with all other ordnance, whether large

or small, and the duties of No. 1 who aims and fires are not more important in this case than those of the higher numbers, who have simply to fill the hoppers. To the uninitiated this may appear somewhat strange; but it is here that it will be found necessary to have men well trained to their work. It may seem an easy thing to fill a hopper, and yet an expert hand cannot do the work under thirty seconds, and could not keep up this rate of filling. In action if he filled continuously two hoppers in one minute and a half, it is all he could do. But a hopper for the five-barrel gun only contains fifty cartridges. The gun will fire ten times that number per minute at close quarters, where rapidity of fire is essential. Hence ten full hoppers have to be passed up to No. 2 every minute. Consequently, at least five men are required, supposing they each fill two hoppers per minute, which no man can do for long. The Alt carriage holds 5,000 cartridges, which at the above rate would be expended in ten minutes. I do not believe that any machine-gun will ever be called upon to keep up such a rapid continuous fire for so long a period as ten minutes, as it seems to me that if the fire be well directed the enemy must be repulsed or annihilated before he can reach guns pumping lead at such a rate. The final rush is never begun at a greater distance than 500 yards from the point attacked. The skirmishing up to this range would afford but few opportunities for lengthened periods of machine-gun fire. The final charge will be arrested in the first two minutes; if not, the chances are that the enemy will charge home, as they did on the plains of France in 1870 and later on in the Soudan.

It will be seen that the Alt carriage carries six rifles. The numbers to whom these rifles belong carry them slung from the moment the gun gets into action, when, if attacked by cavalry, they at once form up, three on each side of the gun, to protect Nos. 1 and 2, and the higher numbers employed filling hoppers in the rear. I maintain that machine-guns, in whatever way they may be employed, should always be worked by men specially trained, and for this purpose it is necessary to create a machine-gun corps, with a depôt at which to drill the men. I would form this corps of detachments of all arms, and as soon as the Officers and men have become proficient they should be sent back to their own corps or regiments. I would, however, retain at the depôt a sufficient number of men to man at least 200 machine-guns.

Allowing 20 men to each gun, this would need only 4,000 men, and 250 Officers, allowing a subaltern for each gun and a Captain to every battery of four guns.

I have tried to work these guns with 8, 10, 14, and 17 men, but find that 20 should be allowed to each. Seldom will it be possible with this number of men per detachment to turn out on parade more than 17 men per gun. Of these, six should be armed with swords and revolvers, the remainder should carry rifles or carbines, sword-bayonets and revolvers. Each man should have a hopper in a leather case strapped to his back, each hopper containing fifty rounds of ball cartridge. This would enable the gun to fire for two minutes

before the men filling hoppers would be called upon; it would also give the men time to settle down to their work.

I find it is necessary to examine every part of the breech mechanism before bringing the gun into action after a march, even when made over good roads, but when the gun has been taken over rough ground this is absolutely necessary. This duty is performed by Nos. 1 and 2, while Nos. 3, 4, 5, and 6 open the limber and carry the first drawer-full of ammunition three paces to the rear, deposit it on the ground, and stand by to pass up the filled hoppers, while 7, 8, 9, and 10, and the higher numbers go on filling. When threatened by cavalry or otherwise, the six highest numbers grasp their rifles, fix bayonets, and fall in on each side of the gun, coming down to the "prepare for cavalry," and using their rifles as opportunity offers. By this organization the feed of the gun is uninterrupted, while its defence is assured. The gun can also be advanced with its muzzle to the enemy, the higher numbers manning the drag-ropes, 7, 8, 9, and 10 supporting the trail, while 3, 4, 5, and 6 carry the magazine and spare gear.

By means of constant drill my men have succeeded in getting so well accustomed to their work that when on the march they can from the command "Battery—Halt!" "Action—Front!" (right, left, or rear), go through every motion correctly, fix distributor and filled hopper and fire 50 rounds (10 volleys of 5 rounds each) in 18 seconds. They have done this work over and over again in this time. I have taken them unawares when on the march at Aldershot and in the Portsmouth country, but they were always ready and equal to the occasion, seldom requiring over twenty seconds to fire the rounds. But when untrained they took three to five minutes to do the work. Now what does this mean? Would an untrained private of the Regular Army be able to work the gun more smartly? If it took three months to train 100 Volunteers in such manner as to render them self-reliant, and able to work the gun in the field, even though every Officer and non-commissioned officer fell out, would it take a shorter time to train Officers and men of the Regular Army? I think not, for the work is as new to the one as to the other, and the regular soldier cannot be credited with a greater intelligence than the Volunteer. The former excels at drill because he is always at drill; my men excel in working a machine-gun because no other body of men have been trained to the work. It will take as long a time to drill 100 Regulars as it took to train the 100 Volunteers, unless the former were made to drill longer hours; even then it would take at least a month to accustom the men to the guns. But in a month a war may be nearly over. The men could not be sent into the field while untrained, and to place machine-guns on baggage wagons or artillery limbers, or to send them with cavalry before the men are trained to their use, is simply to court defeat and disaster. The guns under such circumstances become a source of weakness, instead of one of strength, an incumbrance instead of an efficient means of defence.

Consequently, before machine-guns can be used with success and

intelligence, first must the men be trained, and the smarter these men are the more efficient will the guns be found, the more destructive will be their fire, and the less likelihood of their being put out of action through jambs and other mishaps arising at critical moments.

That the tactical value of this arm is great, when properly served, no one will deny. Of its strategical importance I will say little. Machine-gun tactics do not exist, and the proper position of this arm has not yet been determined. At Portsmouth and at Aldershot I was not allowed to move my guns without an escort. In vain I assured the General and the Umpires that my guns were self-supporting; each gun having its own small-arm men. It was of no use, escort I must have and escort I must wait for, or submit to be ruled out of action. And when I got my escort—a volunteer company of men not half so well trained to support fatigue as my lads who had been knocking the guns about for two years—of what use was that escort? Could it keep up with the guns? No. Guns in my opinion should, when in action, creep or sneak, or move at the double to seize positions. There must be no indecision or loitering; hence we nearly always move at the double, and our escort after a 500 yards spin would gradually assume the form of a comet, the commander and his subs forming the nucleus. On one occasion a Staff Officer rode up to one of these escort subalterns who happened to be well in the rear on the Eelmore Bridge road, and asked what he was doing there. "What are you, sir?" queried the S.O., who was somewhat astonished on receiving the reply, "Leading guide of that company, Sir, disappearing over the brow of yonder hill." A look at the plight of the Officer struggling up the hill was enough for the S.O., who rode off to tell the tale to many a comrade. But the guns had gone up that hill at the double, and were already in position or in action before the escort appeared. Hence I believe these guns will be found of immense service in seizing positions some distance in advance, and in holding the same until the main body comes up. It is all a question of training the men.

They will also be found of use in defending roads and bridges, ditches, and breaches in fortifications, earthworks in the field, mountain passes, and river fords; but I do not believe in their use in the fighting-line of an attacking force. They offer too great a target. I would sooner use them from a sheltered position to support the fighting-line. I believe they will be of great use in flanking or turning movements, especially if they can be brought up on the flank of the enemy's artillery, when in a few minutes there should be neither gunners, drivers, nor horses to work the guns. I am, of course, alluding to rifle-calibre machine-guns, having an extreme range of 3,000 yards. These, as also shell-firing guns of small calibre, should, when used for outflanking purposes, be mounted on carriages similar to the one invented by Lord Charles Beresford, and termed, very appropriately, galloping carriages, as, from the wider *détour* it is always necessary to make, horses alone could cover the distance in a reasonable time.

Shell-firing machine-guns are artillery, and should be used as such.

I cannot conceive anything more demoralizing than for a brigade to be opposed to the fire of even a single battery of shell-firing machine-guns. It is bad enough already when the shell fall from each gun at the rate of two, or at most three, per minute. Imagine what it must be when each gun will be able to send fifteen to twenty shells per minute on their demoralizing and destructive errands. One shell is far more demoralizing than a volley of rifle bullets. When the latter are *heard* the soldier knows that all danger is passed; but when the shell is heard he knows not only that the projectile is coming but also that the explosion is near at hand. Of this I had ample evidence in the Franco-German War.

I do not consider myself justified, for many reasons, in discussing the relative merits or demerits of the various types of machine-guns now before the public, my position as Editor of a Service Journal demanding the strictest impartiality in such matters. My sole object in delivering this lecture is to call prominent attention to the fact, that no matter what type is adopted for Her Majesty's Service, that type will undoubtedly disappoint all expectations, unless the men told off to work the guns are, in the first instance, thoroughly trained to their use. Hence I sincerely hope and trust that before machine-guns are again used in the field a machine-gun corps will be formed, and the Officers and men thoroughly trained, so as to minimize, so far as human foresight can, the chances of the recurrence of such disastrous consequences as attended the abuse of the use of machine-guns by the French in 1870, and by our own troops in the Soudan.

Machine-guns have been divided into three distinct systems. Between the mitrailleuse and the rifle there is an intermediary arm —the magazine-rifle. This is exclusively an infantry firearm, requiring, however, special fire tactics for its use, as it possesses a greater fire-power than the ordinary line rifle, their relative rates of expenditure of ammunition being as about 1 to 2. When the Bethel-Burton magazine-rifle was recently under trial at Enfield, an expert was set to fire it; so rapidly did he manipulate the lever that he did not give time for the hang-fire cartridges to ignite and explode in the chamber. They were extracted so quickly that they actually exploded in the firer's face, and, I believe, the rifle was condemned on that account. Here, then, we have an instance of a useful arm condemned owing to its unintelligent use—to its abuse, in fact—as neither the rifle nor the machine-gun is responsible for the defects to be met with in the ammunition. The same thing has happened to the Gatling gun with its new "positive feed." Some North American Indian chiefs were invited to see this gun fired. With such rapidity was it worked, that the hang-fire cartridges were extracted and thrown on the ground before they ignited, and they then exploded among the legs of the bystanders. The Indian chiefs took to their heels and bolted, and no persuasion could induce them to return to that gun. At Aldershot, when firing Nordenfelt guns, several cartridges hung fire, and the explosions thus caused in the distributor and hopper so burnt the men of the Central London Rangers working

the firing lever, that they were driven from their guns. A momentary panic ensued, during which an enemy might have captured those guns with ease. The same has happened with every other type of rifle-calibre machine-guns except the Maxim. The other types are also liable to be choked by the extractor tearing off the base of the cartridge-case, thus leaving the metal case itself in the chamber. The bullet of the next cartridge presented to that chamber gets wedged. The cartridge itself gets crushed and cut by the force exerted to drive it home by the improperly-trained man working the lever. The gun is at once jambed, and whilst unable to fire from this cause, the enemy are upon it, cut down its detachment, and capture the gun and its position. This is solely caused by the unintelligent use of the arm, or by the ammunition supplied being of faulty manufacture.

The mitrailleuse represents a concentrated infantry fire, delivered from a relatively small space, so long as the gun is clear and in working order; also a concentrated case-shot fire, within infantry range, and that from a very mobile piece of artillery. The concentration of mitrailleuse fire, as compared with the line rifle, is established as being 100 to 1; from which it follows that, with the magazine-rifle, it stands as 50 to 1. Compared with the field-gun its effective range of case-shot fire is as 5 to 1, 300 yards being considered the limit of case-shot fire, and 1,500 yards that of mitrailleuse fire. The concentration with case-shot range is as $2\frac{1}{2}$ to 1, assuming a mean of the number of bullets in a case-shot of the 9-pr., and the 13-pr., with a speed of fire of two shots per minute.

The revolving cannon represents a highly concentrated and complete but light artillery fire. Within artillery case-shot range, its concentration of case-shot fire is to mitrailleuse fire 2 to 1 (speed of fire being eighty shots per minute with twenty-five effective pieces to each shot), and to artillery fire as 5 to 1. Its range of case-shot fire is to that of the mitrailleuse as 1 to 5, and is equal to that of artillery fire. Its concentration of shell and shrapnel fire is to that of artillery as 25 to 1. (The carriage being non-recoiling, and the gun being provided with traversing gear, speed of aimed fire for continued effective fire is reduced from the maximum of eighty shots per minute to fifty per minute.) In destructive power against obstacles, it is to field artillery as about 1 to 5. This is assuming for combined penetrating effect of shell and weight of effective pieces of shell and shrapnel 1 to 4 as compared with the 9-pr., and as 1 to 6 as compared with the 13-pr.

The quick-firing shell-gun presents a complete and concentrated artillery fire. Within artillery case-shot range, its concentration of case-shot fire is to mitrailleuse fire as 1 to $1\frac{1}{2}$, and to artillery fire as 2 to 1. Its concentration of shot and shrapnel fire is to that of the revolving cannon as 1 to 4, and to that of field artillery as 6 to 1. In destructive power against obstacles it is to revolving cannon as 3 to 1, and to field artillery as 1 to 2.

In mobility, the magazine-rifle is equal to the line rifle. The single-barrel mitrailleuse is inferior to the rifle, and superior to the field-gun. The multi-barrel mitrailleuse, the revolving cannon, and

quick-firing gun are equal. In field service it is considered that for the transport of gun and ammunition the same total weight will be found for the three, and this weight is so subdivided, as to require practically the same means of transport. The abstract military powers of these guns are closely represented in the following table, which although subject to even considerable modification, under special circumstances, gives a true basis for ascertaining the comparative military value under the different fundamental applications :—

	Concentration of infantry fire.	Concentration of case-shot fire.	Case-shot range.	Concentration of shell and shrapnel fire.	Shell and shrapnel power.
Normal rifle	1	0	0	0	0
Magazine rifle	2	0	0	0	0
Mitrailleuse	100	$2\frac{1}{2}$	5	0	0
Revolving cannon .	0	5	1	25	1
Quick-firing gun ..	0	2	1	6	3
Light field piece...	0	1	1	1	5

It is most important to bear in mind that whilst it is easy to prove the above comparative analyses of the relative superiorities of these new arms, and to attribute in special cases even higher values in one or more of the factors, it does not necessarily follow either that all of these systems should be introduced into the equipment of every army, or that the adoption of one does away with the necessity of adopting another. The operation of large entirely equipped armies gives rise to certain very prominent circumstances of service; those of well equipped and handled armies against forces only large in number bring other considerations into prominence. What is termed guerilla warfare brings an entirely different set of cases under our notice, while the operations of troops in suppressing riots and local uprisings afford us examples of situations differing from all cases above referred to. As a general illustration, let the armaments of nations be arranged to meet the above special requirements. Austria, with no Colonies, and a minimum of chances to send armies against other than thoroughly equipped foes, is bound mainly by the first conditions. England and France are constantly brought into contact with half-civilized hordes surrounding their Colonies, and have the corresponding circumstances brought into prominence. The United States, constantly campaigning against savages on the war-path, must specially provide for guerilla warfare. In the same country the totally distinct National Guard has for its prime necessity of existence the maintenance of local order and the suppression of riots. The possibility exists that an Austrian Army may conduct a guerilla warfare, or the United States Army may be opposed to a thoroughly equipped European force. It may be wise to provide for the even-

tuality, but it would be neither wise nor economical to provide for it at the sacrifice of more probable contingencies, or to a greater extent than the probability demands.

The systems into which I have divided machine-guns are generic, each having its well-defined limits of service under all conditions. It may be stated as a military axiom that a generic system having been determined upon, but one type or system should be introduced. As an example, there exist several well-established types of mitrailleuses, all belonging to precisely the same generic system, having the same mobility, power, and speed of fire, and only differing in mechanical principles. If sufficient reason exists for the introduction of one of these types, then, since in military value they are alike, the mechanical principles of this one must be considered, either actually superior to the others, or capable of more complete development. That is to say, that shell-firing guns of the same type and of any calibre, as well as the mitrailleuse, can be produced, thus dispensing with an endless variety of systems and drills to obtain the same result. It follows then that other systems or types should not be introduced, either simultaneously or at such short intervals as shall keep the generic system in a constant state of change. Substitution may take place, intermingling never, and no substitution should be made until a new system or type has been developed, entirely and indisputably superior to the old one in all qualities.

In the English military and naval light artillery equipments are found the maxima of types of the same systems.

The official reason for this intermingling is that such a practice prevents the growth of monopolies, and incites competition for the perfection of arms. Such a reason has no foundation whatever.

Were England alone concerned in the matter of armament, monopoly might give rise to a neglect of perfection, but the whole world is continually demanding improved arms, so that a constant and close competition must be maintained. Again, monopoly, so far as it concerns the supply of a certain type of arms to the Government, has none of the attendant dangers met with under the ordinary commercial signification, especially in a country fully supplied with Government workshops for the manufacture of arms.

If the reason be sound in principle it must be general in application, and consequently applied to heavy guns. But the absurdity is at once visible of England having in her Service at the same time heavy guns of the Armstrong and Whitworth types, and of the Krupp and French systems.

Major-General Bylandt Rheidt gives in his "Handbook of Field Artillery" a concise and comprehensive definition of the main utility of the mitrailleuse. It is as follows:—

"The mitrailleuse represents a concentrated infantry fire from a relatively limited space, or a concentrated case-shot fire from a gun having great mobility. It is effective in the defensive and in surprises when its march can be covered; it may render excellent service in the offensive, but it is not possible to utilize it in such cases except in an entirely exceptional manner. Mitrailleuse batteries should be

employed principally in the defence of localities, entrenchments, defiles, thickets, and villages against an enemy seeking to capture these positions by assault. They may be used to either sustain or replace either infantry or artillery in positions where either a powerful case-shot fire is needed, or where an intense salvo fire is required from a limited space. They should never be used except against troops, particularly when in masses, columns, squares, or closed lines. They should never be used against artillery, except they may approach it by surprise, or take it in flank, at a range not exceeding 1,500 paces."

From this definition several important points are clearly brought out, that must be carefully borne in mind in any discussion. The mitrailleuse is neither a pure infantry arm nor a pure artillery arm. It is not an offensive weapon; this is an especially important point, for, as the General remarks, it may render excellent service in the offensive, but such circumstances are exceptional. Being so they have but a secondary importance in considering the absolute military value of the weapon. It must be used against massed troops. Now it is not meant that it cannot be used against deployed troops, but that such use gives to it a minimum of efficiency.

In considering the applicability of any generic system to infantry, cavalry, and artillery service it is necessary to keep constantly in view the distinction between the two branches into which the subject naturally divides itself. These are, 1st, the discussion of the utility of the system as an arm of the corps under consideration; 2nd, its utility as an arm with that corps. As an example, the magazine-rifle is an infantry arm, as pure as the normal rifle. Being purely an arm of that corps, any discussion of its utility as an arm *with* infantry (such as the consideration of arming certain battalions only with the magazine) becomes a matter of secondary importance in establishing its absolute value. It may be discussed with equal importance both as an arm *of* and *with* cavalry; that is, as in the hands of cavalry or bodies accompanying it. It may be discussed as an arm *with* artillery, but not *of* it, for in so far as general utility is concerned the personal arms of the artilleryman are completely effaced in the presence of a discussion of the main field of service of that branch. The sabre and the lance of the cavalry never completely efface the revolver, the carbine, and the rifle. Indeed, in those two bodies, now so universally recognized—dismounted cavalry and mounted infantry—the rifle and carbine completely efface the sabre and the lance.

It is often stated of the mitrailleuse, especially of the single-barrelled one, that it is a small-arm and not a gun. This is not a statement upon which a valid discussion can be based, for it is only half true and is wholly misleading. It is neither a small-arm nor a gun, but it possesses properties belonging to both, and these properties which give it a superiority as compared with one, form embarrassments in comparison with the other. The magazine-rifle is the maximum development of the pure small-arm, the revolving cannon is the minimum development of the gun, the mitrailleuse stands between the two. Batteries of mitrailleuses may have the organization of

artillery, but they cannot be discussed as artillery, since they cannot fulfil its main requirements. Mitrailleuses have infantry fire, but they can neither be given infantry organization, nor can they fulfil the main requirements of infantry service.

If a body of infantry be armed with magazine-rifles, its power of concentrating fire will be doubled under all circumstances, for the mobility of the body itself is undisturbed, thus permitting of the same freedom of deployment or concentration, whilst under both conditions the rapidity of aimed fire is doubled. The question of the utility of making a substitntion of the magazine for the normal rifle brings into serious prominence the question of ammunition supply. This question is, however, of itself too radically considered. However vital the necessity of long maintained concentration of fire, the circumstances of action do not make of it the main feature of consumption of ammunition, much more depends upon individual intelligence in the use than in actual rapidity, so that a thoroughly trained body of infantry may develop the full superiority of the magazine-rifle with no greater expenditure of ammunition than average troops with the normal rifle.

With the mitrailleuse the circumstances are quite different. Its highly concentrated fire from a limited space gives it a maximum effectiveness against masses of troops, and a minimum against deployed bodies. It has been stated that the concentration of the mitrailleuse (multi-barrelled) is fifty times that of the magazine-rifle. It is readily seen, however, that against a skirmishing line, for example, fifty men deployed with magazine-rifles, or even normal rifles, are far superior to one or even several mitrailleuses. In order, then, that the superiority of the mitrailleuse should be established, its full concentration of fire must be allowed for under all circumstances of use. That it *may* be used for single-shot firing is no real recommendation, since its utility in such cases is not comparable to the ordinary rifle. With the magazine, however, its use as a single-shot arm holds it under all normal circumstances equal to the other rifle, whilst giving it the full benefit of its concentration.

As an arm to be used with artillery, one of the main claims of the mitrailleuse for superiority is its adaptability to the defence of the artillery itself, and in this respect two different adaptations are presented: 1st, the multi-barrelled gun, which, with its equipment, forms an artillery unit; 2nd, the single-barrelled gun, which, mounted on the gun-limber, forms only a part of an artillery unit. In the first instance the utility of the gun is at a minimum, since on the march it must occupy a specified place in the artillery column; and in the event of sudden attack the time necessary to unlimber and bring this mitrailleuse into action is practically equal to that of the artillery itself; whilst in action, since its *rôle* is entirely distinct from that of the artillery, if held in line its utility is at a minimum. Again, the total force of the mitrailleuse so employed is deficient in strength if detached at any given moment from a battery to act independently. Finally, since mobility of artillery is of the most vital importance, the number of guns per battery must be reduced so as to allow of the

substitution of the mitrailleuse, or the battery unit must be increased, and so make it unwieldy. In regard to guns mounted on the limber, their utility is at a maximum. In this case, however, there are certain drawbacks which need most careful consideration. For example, it has been urged that 1,000 rounds of ammunition is a sufficient supply for a gun thus mounted, but even were only 500 rounds per gun carried, the extra weight thus added to the limber, by gun and ammunition, would be 80 lbs., while the space required for ammunition alone would be 1,000 cubic inches. Hence it is obvious that a sacrifice must be made somewhere, either by overloading an already crowded limber or by reducing the artillery ammunition proper by fully one-fifth, for it must not be forgotten that the chief aim of the artillerist is, and always has been, to lighten and disencumber the limber to the greatest extent possible; and this has already been carried to such an extent that the supply of ammunition at present carried in a gun-limber is altogether inadequate to the demand made upon the gun in the field, while no artillery rule is stricter than that, except in very rare cases, guns must be closely followed by their ammunition wagons, in order to ensure even a fair supply in action.

Consequently, the question can here be asked whether the benefits to be derived from mounting a mitrailleuse on the gun-limber would compensate for the encumbrance thereby created. So far the answer has been that the addition of the mitrailleuse will render field artillery more mobile, by doing away with the necessity for an escort. But this assumption is only well founded when the mitrailleuse is worked by a detachment of trained men, sufficiently numerous to supply the escort. Otherwise, in case of attack, the mitrailleuse would be as powerless as it was in the Soudan. Another drawback to guns so mounted is that the horses and *personnel* of the artillery battery are in the way, and would prevent its being used to advantage, especially when the attack is made in front or rear.

Against a deployed attack from any direction the service that the gun so mounted could render would be at a minimum, as the ammunition it carries would be expended long before the enemy came to close quarters. Even supposing that the mitrailleuse could repulse an attack when so used, it could neither prevent the disabling of the battery horses, and consequent delay in moving the guns, nor could it supply the draught power necessary to replace that loss. Whatever the shortcomings of artillery escorts may be they perform certain necessary duties which the mitrailleuse cannot, namely: 1st, they may keep off the attack by their deployment, and thus give timely warning to the battery, and enable it to shift its position; 2nd, the escort can offer the full power of resistance in whatever direction the attack is made; 3rd, the escort can supply the lost draught power at any critical moment, and prevent the guns being captured by bringing them out of action. For these reasons I am of opinion that unless the mitrailleuse is manned by a detachment sufficiently numerous to supply draught power and escort, the latter cannot be dispensed with, and that the mitrailleuse, mounted on an artillery

limber or baggage wagon with but two or three men detailed to work it, would prove not only an encumbrance but a source of weakness, and not one of strength.

It has been urged for the mitrailleuse that it might be used for finding the range. But since the service of artillery as a firearm commences where that of the rifle ends, it seems scarcely worth while to consider this point.

The mitrailleuse can find its own range up to 1,500 yards, but it is a matter of difficulty to quickly establish the longer ranges, as even with the shells of the artillery it is a difficult task, one the rifle-bullet of the mitrailleuse is totally incompetent to perform.

From the foregoing I draw the conclusion that, whereas the rifle-calibre machine-gun or mitrailleuse should be used as before stated, solely by or in conjunction with infantry, machine-guns of larger calibre, throwing explosive shell at the rate of from fifteen to, say, thirty projectiles per minute, should belong entirely to the artillery. Furthermore, that the infantry machine-gun must fire the infantry ammunition, must at all times have a spare ammunition wagon close handy, and must never depend upon untrained men for its manipulation in the field. Finally, since the mitrailleuse is neither a pure infantry nor artillery arm, but is under many circumstances of the highest value as an auxiliary to either, it should be given the maximum freedom of action in order to fully furnish this auxiliary service. It should have a complete organization, and this organization should be to the highest degree self-reliant. On the field it should not be hampered with unwieldy escorts, but should be permitted to accept great risks, in order to derive its highest benefits. It must not be forgotten that whilst it is possible for a mitrailleuse to be as effective as a battery of artillery or a battalion of infantry, its loss on the field of battle would never be so serious as that of either of these two.

In conclusion, allow me to express my thanks to the inventors of machine-guns who have responded to an invitation I sent them to forward me the latest data that they possibly could connected with this arm. From that data I have been enabled to compile this paper, and give you most of the figures and facts which I have brought forward to-night. Our Secretary, Captain Burgess, has been kind enough to place in my hands a pamphlet written by Lieutenant Benson, R.A., "On a Machine-gun Battery and its Equipment." That pamphlet was written before my lecture, but only came into my hands since my own paper was printed. In it Lieutenant Benson advocates exactly what I have advocated for these guns—perfect freedom of action in the field, so as to utilize to the utmost their great mobility, especially when properly mounted. I will not say anything more about Lieutenant Benson's paper, because it will be detracting from its value when it appears in the Journal.

Admiral Boys: My lord and gentlemen, I shall detain you but a very few minutes, and will leave it to those more recently connected with these guns to enter into the main discussion of the subject. The fact of the matter is this, I happened at the time mentioned, to hold the position of Director of Naval Ordnance. My assistant, Captain Hall, was sent to Sweden to witness some torpedo experiments there, and came across what I believe was the original Nordenfelt gun. He was so much struck with it, and our Gatling guns had been so frequently failing, that he made a very good report of it to me. I reported on it to the Admiralty, and we had some communication with the Director of Artillery on the subject. He at first did make

objections, not I think to the gun itself, but at that time the War Office had to provide in their estimates the money for all our naval ordnance materials, and he had not any money to assist us with. I do not recollect myself that he made any objection to any individual gun. However, it did happen that the late Mr. Ward Hunt, First Lord of the Admiralty, pressed on the Secretary of State for War that the Navy really wanted this gun, that it was a great improvement on the Gatling, and instead of having a Committee which was proposed, and which we objected to at the time on the score that a Committee might cause delay, and it was really urgent for the Admiralty to have some of these guns (I think Mr. Nordenfelt will bear me out), the contract was drawn up in my office at the Admiralty and concurred in by the War Office. We ordered the guns, and the War Office approved them and paid for them. I see the first point of detail is the Boxer cartridge. The Boxer is a soft cartridge, and is not adapted to rapid-firing machine-guns. The consequence was the Committee reported this, and a solid-drawn cartridge was approved for machine-guns. It was considered to be a *sine quâ non* that the machine-gun cartridges should be identical with those for the rifles. When the solid-drawn cartridge recommended by the Machine-gun Committee was adopted, they had in view the object that the Martini-Henry rifles should ultimately be altered to take this cartridge. However, that fell through for various reasons, and I am glad to hear that a solid-drawn cartridge of a new description is to be introduced for our new rifles. Captain Armit says after this he went to Shoeburyness, and found "the experiments went entirely in favour of the Nordenfelt mitrailleuse." Of course that was Captain Armit's opinion, but it was not the opinion of the Committee then, nor do I believe that it is now. I can assure you that in my experience of five years as D.N.O. at the Admiralty, we always obtained as far as possible from the War Office what was reasonable and necessary for the Navy. I am happy to say the Navy now have many of these ordnance equipments in their own hands, and they are not dependent altogether upon the money taken in the War Office estimates. There is one other point of detail I should like to touch upon, that is the question of weights—I am alluding only to small machine-guns. The weight is hardly an element in the system of rifled machine-guns, because any one will see here in the guns before us, that the barrels are the same; the system is only different in the action at the breech, and the difference in weight of the action of one system and another can only be a matter of a few ounces. The weight is in the frame and mounting of the weapon, which has comparatively nothing to do with the system. A great deal more has been made about the comparison of weight between these small machine-guns than there is any occasion for. You may increase or reduce the weight as you please consistent with strength in the framework and the mounting, but I must tell you the heavier the mounting in comparison with the barrel, the steadier and better is the shooting of the gun. I know that great improvements have been made in the Nordenfelt rifle machine-gun, and all the defects (not very important) that were exhibited before that Committee have now I believe been thoroughly removed, and the only difference in efficiency between the two guns, the Gardner and the Nordenfelt, is that one has the reciprocating or pump-handle motion, and the other the rotary or winch-handle motion. Some people seem to think one is more detrimental to good firing than the other. My own opinion is the rotary motion is the more steady and the better of the two, and not so likely to pull the gun over; but I would not condemn either gun for the reason of the manner of its being fired in one way or the other. I will not detain you any longer. I have no doubt there are many here who will make some remarks on the state of the machine-gun question in the present day, but as I regret to see in the remainder of the paper there is little or no reference made to the use or abuse of machine-guns on board ship, I have nothing more to say in discussing this paper.[1]

Mr. C. FREDERICK LOWE: My lord and gentlemen, there is one matter of detail as to machine-guns which has not been touched upon by Captain Armit, or in the

[1] Captain Armit having withdrawn certain statements respecting the action of the Machine-Gun Committee, Admiral Boys has withdrawn his objection to those statements.—ED.

lecture recently given by Major West, of the Royal Horse Artillery. I was very much struck in reading General Gordon's diary at Khartoum to see a suggestion made by him that machine-guns should be fitted with telescopic sights. That suggestion appears to be extremely practical. Colonel Walker, who was on the Staff at Hythe and Fleetwood, in a book about rifle shooting, published in 1865 (p. 180), says that "a telescope about six inches long with cross wires may be fixed to a rifle without any other sights and with excellent results. The Confederates had some hundreds of Whitworth rifles with adjustable telescopes, and were thus enabled to distinguish and kill Officers at 1,500 yards." Therefore more than a quarter of a century ago muzzle-loading rifles fitted with telescope sights were tested on active service. I also remember reading a statement that during the siege of Charleston one skilled marksman furnished with the best possible rifle of the day, but whether it had telescope sights or not I am not quite sure, was enabled to silence a gun. As soon as ever a gunner appeared at the embrasure he was picked off, so that one rifleman's fire with a muzzle-loader was sufficient to silence one cannon. Within the last year or two, telescopic sights have been brought to perfection and fitted to sporting rifles by Messrs. Fraser, of Edinburgh, who are also of opinion that they would be equally well adapted for military purposes. I believe that Sir Henry Halford with the new Martini-Enfield rifle has put as many as ten shots into a square of six or eight feet at 2,000 yards. That is with his own unaided vision, and with the naked sights on the rifle. How much better practice could we have made with the Martini-Enfield rifle if it had telescopic sights, I am not prepared to say, but in all rifle shooting we, of course, have the human body as a carriage, and that has been very aptly described by a well-known medical authority as a "palpitating mass," while in the machine-gun we no longer have this factor, but a steady platform for firing the bullet, and with uniform ammunition and a uniform state of the wind there would seem to be no reason why each barrel of a machine-gun should not put a series of bullets through the same hole. I therefore most respectfully submit that due attention should be given to the very practical suggestion made by the lamented and gallant Officer the late General Gordon as regards telescopic sights.[1]

Lieutenant TUPPER, R.N.: My lord and gentlemen, I hope that the position I hold as one of the Staff Officers on board the "Cambridge," in which I am daily brought into contact with machine-guns, will be some excuse for my presumption in addressing so many distinguished and experienced Officers. In the first place, it has always appeared to me, since I have been Instructor and have been instructed myself in machine-guns, a notable fact that in our Service we have not got a single machine-gun. We have the quick-firing Hotchkiss, but we have not a single machine-gun in which No. 1 both lays and fires his own gun. In our musketry instruction we teach the seaman as a fundamental principle that the object of the third practice of position drill is to establish that union between the hand and eye which is indispensable to good shooting. When he has done his musketry instruction we take him to the machine-guns, where at once he has a different state of things altogether; there is no more union between hand and eye to be established. Union has to be established between No. 1's eye and voice and the hand of No. 2, who works the lever or crank. It is a remarkable thing that everyone has a certain amount of personal error. This was tested in the "Vernon" by an electrical apparatus. When you gave an order to a man you broke one circuit, and on acting upon your order he broke another circuit, and that showed the time the order took to penetrate his brain and make his hand work. When you come to fire these machine-guns on board ship, the ship is probably rolling. No. 1 looks along his sights and is to fire when he has a half sight. Just as the gun is rolling *up* he gives order to No. 2 to fire; No. 2 fires, he has a little personal error, and the shot goes wide of the mark, that is, over it. Time after time firing the Nordenfelt gun in the gunboat, I have found that I could not get the men to make good practice when they were firing

---

[1] A paper was contributed by Lieut.-Colonel D. Davidson, late of the Bombay Army, on his "Patent Telescopic Rifle Sight" in 1864. *Vide* the Journal, vol. viii p. 426, *et seq.*

what we call "volley firing." When I gave the order "rapid firing," and the No. 1 had to keep his sights on, and the gun was fired as quickly as No. 2 could work the lever, we got better shooting. I therefore think it would be advisable, if possible, to adopt the Hotchkiss system of mounting with the shoulder-piece for all machine-guns, and to do away with the somewhat complicated training and elevating gear which we now have in the Nordenfelt and Gardner system. Here before us is a practical illustration of the Hotchkiss mounting. It is a rigid mounting, a pair of trunnions on a vertical spindle, and in working it with the shoulder-piece, you keep your sights on by elevating the gun and training it at the same time with your shoulder, having your right hand on the trigger to fire the gun directly your sights are on. That is a principle which I think can easily be adopted in our machine-guns, and in that way you would secure the condition which is considered in musketry indispensable to good shooting. In the next place, as to the sighting. Hotchkiss introduced a sight by which No. 1 could pick up his distance at once. In the "Excellent" a similar idea was suggested recently: it consisted of a sight which was like a ladder and graduated up to some 1,200 yards; the thick rungs of the ladder were the even hundreds, and the thin rungs the odd hundreds. The sight is hinged at its base so that when not in use it lays flat on the frame—when you are firing the guns the sights stick up in the form of a ladder and then with distances rapidly altering, No. 1 could at once pick up the rung of the ladder corresponding to the distance at which he estimated the object to be. As we drill at present, we have a man each side of the gun to keep the sights adjusted. They have either to estimate the distances respectively, or else they have to get it from the Officer in charge or from No. 1. It takes some time to adjust the sights now in use to the various distances, and besides, Nos. 2, 3, and 1 may differ in their ideas. Therefore it strikes me that if you had this upright sight in the form of a ladder, so that on estimating the distance of the object, No. 1 could take his sight from the rung which corresponds to that distance, the speed and accuracy and efficiency of sighting might be increased. I see Captain Armit laid very great stress on the necessity of having men thoroughly trained in working machine-guns. I cannot too strongly emphasize his advice myself. In my position I cannot criticize the regulations for the instruction of the men, I have merely to carry them out, but I do not think I should go outside of my province if I placed the results before this Institution. I have questioned two or three men who were at Tamai aud El Teb, and they said they did not see anything wrong with regard to the gun whatever, they only said that if they had known at that time what they know now about the details as to mechanism, and the faults that occur and the methods of rectifying them, that those guns would never have failed or jambed at the critical moment. I believe in the Gardner system thoroughly myself, I have seen a good deal of practice with it. We have a field Gardner gun in the "Cambridge" now, that has been working steadily for four years, and it has never had a missfire or jamb during the whole period, simply because the men who work it know how to manipulate it; it works very well, and it always gives good results. But I do not altogether like the Gardner gun as it now is. I think it is too heavy, but I think that the weight might be rectified. I do not see why it could not have a light steel frame and a steel box for the locks, instead of the heavy metal now in use; the barrels also are very big and clumsy, but I do not see why they could not be made as small and compact as those of the ·45 Nordenfelt. What I do like about the Gardner gun is its great simplicity, and I always find in examining blue-jackets they do not make so many mistakes about the Gardner gun, they seem to grasp its mechanism easily. They do get a little mixed over the Nordenfelts, but the Gardner gun they always seem to able to be explain thoroughly; they can take a lock to pieces and put it together again in a minute. Again, if the cartridge does not extract properly and is jambed in the gun, all you have to do is to open the cover of the Gardner, take out the lock, and then you can go on firing your four barrels in less than half a minute; whereas with the Nordenfelt, if the cartridge is jambed you cannot remove your plunger quickly, and you must get the cartridge out of the barrel with a cleaning rod before you can continue the fire, and this takes longer than it does to take a lock out of the Gardner gun, and that is a distinct disadvantage in action. As a lubricant for these machine-guns I have

found vaseline of great assistance. I have put vaseline on these machine-guns, and in spite of using them constantly for drill for ten or more days without relubrication, they have been as clean in the internal mechanism as they were when it was put on. That is not the case with oil, which seems to dry up more quickly and clog more.

Colonel ALT: Lord Charles Beresford, my lords and gentlemen, having taken the interest which I have in the question of the use of machine-guns for infantry purposes, I feel it is, perhaps, incumbent upon me to make a few remarks upon the very interesting paper which we have heard read. While agreeing generally in principle with the lecturer, I have a few exceptions to take in detail to some of his remarks. I will not say anything about the relative merits of machine-guns, I have no doubt machine-gun makers can take care of themselves in that respect. I have studied them all, but have had more particularly to do with the Nordenfelt gun, and I have my own opinion with regard to it, which is a very favourable one. As to the jambing of cartridges, I have generally been present at Aldershot and elsewhere, when experiments have been made with our Nordenfelt guns. I have always had reports made to me, and I have carefully enquired into any cases of jambing or explosion that may have taken place, and have found that they have occurred with blank cartridges. It is very difficult to manufacture blank cartridges to fit and work accurately with the machine-gun, because they cannot be made of the same weight as loaded cartridges, and therefore they do not drop so readily or so accurately from the distributor into the breech, and occasional jambs and hang-fires have thus occurred from faulty blank cartridges. I believe that when it is better understood and when used with loaded cartridges there will be found very few instances of jambing or hang-fire with the Nordenfelt machine-gun. With regard to the training of men, there can be no question that to work these guns the men ought to be properly trained. I do not agree with the lecturer in his view as to the establishment of a special Machine-gun Corps; my own idea is that every man in a battalion should be made to work these machine-guns. It is true that our men take about three months to learn the drill, but Volunteers only drill at irregular times at night, and I maintain that for men of the regular Service, a month at most would be quite sufficient to make men perfectly efficient in the use of machine-guns. Instead of a distinct corps every man of the battalion should be able to take his place in working the guns when occasion requires. The guns are of course of great use for defensive purposes; but I claim that for purposes of offence the guns would also be of great use. I have proved this at Aldershot and elsewhere, several years running. With the assistance of the gallant lecturer and other Officers attached to the guns, we have moved them up rapidly with the fighting line to demonstrate their mobility, and with most satisfactory results. For outpost work too they would be invaluable. I do not agree in the possibility of their being very readily captured, because our men are able to pick their gun up and run away with it as quickly as any rush could be made upon them by any fighting line if such an occasion ever arose. My reason for saying that every man of the battalion should be trained at the gun is that you cannot make omelettes without breaking eggs. You cannot carry fixed positions without making sacrifices. You never think anything of the sacrifice of men in seizing a position, and I do not know why you should make so much of the loss of one or two machine-guns if the occasion arose requiring it: therefore I maintain that they should be pushed forward in the fighting line where the doing so would be of advantage, and that any men of the battalion should be ready to take the places of those disabled at the time. Then with regard to the range at which these guns can be worked, one great advantage of the long-range firing at which they are capable of being used would be against artillery. I think we demonstrated that at Aldershot at the rifle ranges at Cæsar's Camp. On one occasion it was perfectly startling to see the effect produced upon volley targets by a few hundred rounds fired at ranges from 500 to 800 yards. Sir Archibald Alison, commanding the artillery at Aldershot, and a great many other Staff Officers were present, and I am sure they were impressed with the disastrous effects which would have been produced upon artillery deployed, by the fire of one machine-gun. By the use of a range-finder, the range is very easily obtained with the sights upon the guns or in the same manner as with shrapnel

shell fire; upon any ground where the dust is thrown up or an explosion can be seen, you can pick up the range with machine-guns. You can begin at short range, and by gradually elevating your gun you can pump the lead along until you pick up the range of the artillery or other objects, and the effect that would be produced by the splashing of lead upon the guns, tyres, and limbers, and by direct hits upon the men or horses of a battery of artillery as far as it was exposed to view, would be very great indeed. Then with regard to the number of men, the lecturer laid some stress upon the fact of twenty men being necessary for the gun. These remarks might be misunderstood. No more than ten men are necessary for the working of a gun. It is quite true that if we want to keep up with a battalion in column of route over such ground as the Long Valley, or the Fox Hills, it is necessary to reinforce the gun detachment, by detailing a section from the leading company merely to do animal work of pulling up very steep inclines; but for actually working the gun no more than the gun's detachment of ten men is required. If any of those men are placed *hors de combat,* other men at hand are immediately ready to work the gun, and so avoid the risk of the gun being rendered useless by casualties occurring in the detachment.

Major Lockyer, R.A.: As Inspector of Small Arms I hope you will excuse me if I make one or two very brief remarks on Captain Armit's very excellent paper, with most of which I entirely agree. There are one or two points I think he has omitted, and the chief of them is that although I think he recommends that the men who are in charge of these guns should have a great deal of drill, he never says that it should be otherwise than with blank or dummy cartridges. Now, it has been my province to instruct a great many men in the use of these guns with bullet cartridges, and, of course, there being a large amount of ammunition at the Small Arms Factory, we can fire a great number of rounds. We find, although the men are perfect at their drill with blank or dummy cartridges, that when you get them to work the gun with an unlimited supply of ball cartridges, the gun jumps, makes a noise and much smoke, and for these reasons we find the men who can do very well with blank cartridge or dummies, when they first try with ball cartridge get the gun more or less jambed, and the fire becomes very intermittent, and in many cases it has been stopped altogether for some considerable period. I would, therefore, suggest that very strong stress should be laid upon this, that the corps which I hope will be formed should have a very large amount of bullet ammunition every year furnished to it. There is another point that Captain Armit mentioned about hang-fires and explosions in the magazine. I do not think in any gun that the action is rapid enough to extract a cartridge before it explodes, unless, of course, it has hung fire to a certain extent. We have known very few cases of hang-fires, but a man on one occasion had his fingers blown off when testing rifles for their extraction with a common Martini-Henry rifle, and therefore I think the hang-fire, which very seldom occurs, can hardly be taken into consideration where the mechanism of the gun is concerned. With regard to jambing the great thing to prevent it is, as said before, to practise the men with bullet ammunition. I do not think it is generally known, but in the Gardner two-barrelled gun there is now a very good arrangement by which if one barrel jambs a small gun-metal plate is put behind the breech of that barrel, and that small gun-metal plate, without taking out the lock or anything, stops that barrel working altogether, and you go on working your two-barrelled gun as a one-barrelled gun. This is done within the space of a few seconds in the event of the jambing of one barrel.

Mr. Nordenfelt: I just wish to point out to the gallant Officer of the "Cambridge" that these two-barrelled and four-barrelled Nordenfelt guns are supplied with two lines of sight. The left line of sight can be used when one man aims the gun and another man fires, and the right hand sight is specially provided for use when one man both aims and fires. That is done so in the "Excellent;" I do not know why these instructions have not reached the "Cambridge," but I will inquire about it. As to the lecturer's statements, I like the bulk of them very much, though there are a few things I do not like. There is one statement which I think it is fair to a foreign Government to explain. Captain Armit says that it is wrong to compare revolving guns with rifle-calibre guns, as was done in Russia. In Russia these trials were not between shell guns at all, they were between the Gardner, my

own, and other rifle-calibre guns. It was then proposed, either by the Hotchkiss Company or the Government, that a 37 mm. Hotchkiss gun should be fired side by side with the other guns for the purpose of seeing whether a gun firing small shell might be used under circumstances when the rifle-calibre gun would be useful. It was not a competition between rifle-calibre or shell guns in any way, it was simply that the Russian Government wished to know whether a small 1-pounder shell-gun would practically be as effective as the rifle-calibre guns then in competition. I believe the lecturer's memory has misled him with reference to the explosion which he mentions in one of my guns at Aldershot. I have a letter from the Officer whose trousers were singed, and who states that on that occasion the gun was firing blank ammunition and not bullets. Lord Charles Beresford will remember what occurred at Dartford where we fired blank ammunition; it was very badly made, put together temporarily as a means of trying the gun when moving about in the presence of a number of Officers, and therefore I beg to say I do not consider that is prejudicial to the gun in any way. I quite agree with the lecturer where he states that rifle-calibre guns, as well as shell-guns, would probably be necessary in the field. I would like, however, to state that in using the words "shell-guns in the field," I would eliminate every and all guns which do not fire shrapnel. It may take some time before shell-guns do come in for field work, but we fired last year in Sweden for two months 3-pounder shell-guns with common shell as well as shrapnel for field use, and we found common shells practically useless, even with as big shells as 3-pounders, at 2,000 and 3,000 yards. The common shells exploded often into the ground, or exploded behind something, and then you did not see much of them. I believe shell-guns in the field will be bound to fire shrapnel, because then the distances soon become known, as instead of waiting to see the actual explosion in the ground you see them explode in the air, and the effect against troops was found to be very much greater than that of common shells. That excludes all guns which are of less calibre than nearly 2 inches. I believe that guns as small as 1½ inch firing shrapnel would not be much more useful than rifle calibres, but at the same time as soon as you get to large calibres shrapnel is a great advantage. We fired at Portsmouth the other day 6-pounder case shot with 1,800 feet velocity, and the killing range was about 400 yards. That means that with a 1-pounder shell like the revolving cannon fired in Russia with 1,390 feet velocity, the killing range would be probably less than 250 yards. These case shot in the field are quite admissible and useful if you come suddenly into very close quarters, but not otherwise, and one must absolutely look forward to shrapnel for that purpose. There is no use in making shrapnel shells for anything under 1¾ inches calibre. There is one point I would like to mention about sufficiency of ammunition. When a gun fires from 500 rounds to 1,200 rounds a minute and you begin to add that up, it appears to be an awful lot of ammunition; but I have never yet seen any firing against moving objects or at any respectable range where the rapidity of firing ever exceeded one-third of the maximum rapidity. I consider that the five-barrelled gun for instance, be it Gardner's or mine, would in war practically fire something like 180 to 200 shots a minute. You blaze away for a second or two, then either you have killed the objects you have aimed at, or there is a movement or something comes between. During the experience in Egypt I am told that on no one day in the field, taking the whole day, and there were occasionally some uncommonly hot hours, was there a greater maximum than 1,300 rounds fired from any one of the machine-guns. I believe, therefore, with Lord Charles Beresford, in making the guns as movable as possible, that all you need to carry is about 1,000 rounds in the hoppers, and about another 1,000 to 1,500 in the usual cartridge pockets. That does away with a great deal of the dangerous idea that 10,000 rounds or more are required, which means putting four or six horses to a gun like that. I may also say that while we machine-gun-makers no doubt make a great point of our guns being exceedingly simple, still the simplest possible mechanism requires more training than is generally given to machine-guns as yet.

Colonel LIDDELL, 10th Hussars: I should hardly venture to make any remarks before an audience of this kind had it not been that at the several discussions which have taken place on the subject of machine-guns in this room no one of my branch of the Service, to the best of my belief, has spoken. From this fact it may

possibly be thought that the cavalry branch of the Army does not value this machine-gun, or rather rifle, or appreciate the immense future that appears in store for it. I therefore wish to say no more than this, that a great many of my brother Officers in the cavalry do value it most highly; in fact, we think our branch of the Service is the one above all others to which these guns should be attached. When we are far in advance of an army waiting for infantry it is very often an anxious moment, as any cavalry Officer knows; this gun would then supply the want of infantry till they came up, and therefore would be most invaluable to us. Besides the many contingencies in which they would be of use, I am of opinion that tactically they might be freely employed. Supposing one body of cavalry was about to charge another, the one that had two of these guns on its flanks and could send some thousands of rounds into the approaching cavalry would very much shake it. I am happy to say that the chief of my branch of the Service, Sir Drury Lowe, is a most anxious advocate that these guns should be tried, and I hope, as the regiment to which I belong is at Aldershot, we may be allowed the opportunity of doing so in the coming summer.

Captain Acland, R.A.: My lord and gentlemen, I think the only arm that has not been represented in this discussion is the gunner's. There is a great deal I should like to attack, as a gunner, in Captain Armit's lecture, but I shall not do so. I would not prolong the discussion at all, but as a practical Officer I have been engaged at Shoeburyness in trials of all types of machine-guns, and should like to comment upon one paragraph which Admiral Boys has not alluded to. Captain Armit seems to object to the intermingling of types, and to the adoption of different systems of guns in the Service. He points to our having Krupp, and French, and Armstrong, and Whitworth guns. Surely no one would wish the authorities alone to be the sole judges of what should be adopted in the Service, for it is only by having every kind of gun tried in the Service, and by practical Officers working out the details, that the authorities can possibly decide which is the best system. At Shoeburyness, of course, we have every conceivable invention, good, bad, and indifferent, under trial. Lieutenant Tupper of the "Cambridge" pointed out that he should like to see the ordinary machine-gun with the Hotchkiss shoulder-piece. If a sporting man is behind it I quite agree with him; if a duffer is behind it he had much better have the Nordenfelt traversing and elevating arrangement. Even in his own Service there are plenty of men who will disagree on that point. It is only by bringing questions such as these before practical men, and by "intermingling types," that such questions can possibly be settled either for my branch of the Service or for the Navy. I think that is the special point to which I wish to draw attention, as well as to Captain Armit's rather antiquated ideas as regards case shot. I hope case shot in a few years will be obsolete; but the effective range of case shot from the new type B.L. gun is certainly more than 300 yards. No doubt shrapnel shell will take the place of case shot entirely, being burst with a time fuze at the muzzle.

Rear-Admiral Fremantle, C.B.: I think, my lord, it would have been advisable if the lecturer could have given us a little more completely his ideas with regard to the machine-gun afloat. As we must look to the machine-gun as one of our principal defences against the torpedo-boat, it is very satisfactory to see how the machine-gun is advancing daily, and how many types there are already in existence, as well as the changes which those types do take from time to time. The Hotchkiss gun exhibited to-day is a very different gun from any Hotchkiss which we have ever seen before, and we also hear of different types of the Gardner gun, which certainly do not resemble those with which I am acquainted. I have had a little practical experience of machine-guns, and I have been wishing to speak with a view of stating very much what has been stated by the last speaker, that what we really look to is the question of the experience of those who have tried these guns, and especially those who, like our Chairman, have had the opportunity of trying them in action both on board ship and in the field. That I think is the really important question. So far as my own experience goes, I had the honour in the "Invincible" at the end of 1879 of taking out the first six real machine-guns, the first six Nordenfelts sent out to the Mediterranean. I do not speak of the Gatling, because that we all admit is dead and buried, but the first of those guns which

were at all events supplied to the Mediterranean fleet went out in the "Invincible," and consequently our men had had little or no instruction in the use of the Nordenfelt gun. I am bound to state that those guns were always, as far as I recollect, very efficiently worked, and that we had no accidents, no jambs, or, at all events, very few jambs, connected with them. I think it is due to the Nordenfelt to make that statement. There were some alterations made to them afterwards to the extent of preventing them from being fired when at half-cock and so on. When I commanded the "Dreadnought" last year she was fitted with ten Nordenfelts and four Gardners. I want particularly to guard myself against advocating any particular type of weapons. They are improving from day to day. The advantage which there is in one type is an advantage which is not shared by another, and *vice versâ*. I have heard it stated that in the lecturer's opinion there is a great advantage in the horizontal motion in firing the Nordenfelt gun over the rotary motion used in the Hotchkiss. I am inclined to agree with him there. I think anybody who looks along a line of sight and sees something constantly moving round and round must find it more difficult to take aim; at the same time, we have the high authority of Admiral Boys for a different opinion, and therefore you see in these matters there is a great deal of room for difference of opinion. But I wish to state, as far as my experience goes in the "Dreadnought," there certainly was some trouble caused from time to time by the Gardner gun. Here, again, I am differing in opinion from Lieutenant Tupper, who has had great experience in the "Cambridge." But I should like especially if the Chairman would kindly give us his experience on this particular subject. I have worked with the Gardner gun, and it has always struck me that in the desert or wherever there was any amount of dust it was certain that some of it must get into the Gardner gun, and so prevent the cartridges falling into their place and impede the firing of the gun. Perhaps I am wrong about that. We have had Lieutenant Tupper's opinion that the Gardner gun is perfection, and cannot get out of order. I do not wish to say anything against the Gardner. I did remark that it did fail occasionally to feed properly from some little dirt having got into the feed, and I wish to know from our Chairman if he will kindly tell us whether that was the cause of the jamb which did take place in the Soudan, and if so, whether it could not very easily be obviated by having a closed hopper.

Colonel HOPE, V.C.: I wish to say a very few words, with all deference to what fell from the last speaker but one about the suggestion of having guns of all kinds tried in the Service. No doubt it is a very great advantage. Unfortunately that is just the advantage that the Service is without. The Ordnance Department set their faces resolutely against all inventions in the way of larger ordnance not emanating from Woolwich or Elswick, and nothing is more disastrous than the history of rifled ordnance in this country, unless perhaps it be that of machine-guns.

Mr. ACCLES: My lords and gentlemen, I wish to make a few remarks in respect to the Gatling gun. I have been connected with it for the past fifteen years. It seems to be the prevailing idea that the Gatling "is dead." The Gatling is not dead. It is one of the most lively guns you ever saw. Since the Shoeburyness trials the Gatling has received new life and is again to the front. I have remodelled and rebuilt it. It is altogether a new gun. There is little left of the old gun except the name. It has not yet had a chance to be in competition to any great extent in England, but in other countries where it has been in competition it has always carried the day. It is not necessary that I should remind you, gentlemen, of the good service done by the improved Gatling in the late troubles in the North-West of America. Should there be another competitive trial, you will find that the old or new Gatling will do its duty. I have in remodelling the gun made every movement positive. The extractors and the feeds are positive in all their movements. The cartridges are under control from the time they are placed in the feeds until the fired shells are ejected from the gun. There are no springs in the gun except those in the locks which drive the firing pins forward. If the gun was never fired at a less rate than 300 shots per minute, I could do without them. The cartridges are received from the feed at the top of the gun and fired at the bottom, so in case of hang-fire cartridges the gas or fire cannot reach the live cartridges in the feeder and cause an explosion. Take all the jambs and mishaps, and the number of cartridges that have been fired

from the old Gatling, of which I have helped to fire 2,700,000 rounds, I certainly never knew of a man to be shot or disabled at the rear end of the gun. You will see this proves that the system is at least a safe one. While attending a lecture on machine-guns, by Lord Charles Beresford, in this lecture-room, I found that one of the chief wants was a suitable mount or carriage for a machine-gun. I have designed a carriage with three wheels. The first one I made is to be seen in one of the other rooms. I have arranged the gun so that it has an all-round fire without moving the carriage: it can be given an elevation of 83 degrees for high-angle fire. The gun can be fired while the carriage is on the move. The man who fires the gun rides on the trail. He points the gun by means of a long lever passing under his left arm and turns the crank and fires it with his right at the same time. 5,000 cartridges, 10 feeds, and a tripod are carried on the carriage with the gun. The tripod is intended to be used to fire the gun from in any place where the carriage cannot go. I wish to say a few words about high-angle fire. I am confident that in future warfare it will be a useful and necessary feature in a machine-gun. I have proved by a number of trials with the improved Gatling, using my feed, that it is practicable at all ranges from 200 to 300 yards (elevation from 38 to 82 degrees, penetration from 3 to 6 inches of wood). Intrenchments or breastworks would be no protection whatever; a body of men would very soon become demoralized if not disabled by a shower of bullets falling on or among them. Some time ago I made a trial near Vienna; when finished the Committee said to me,—"You have shown that the gun will do all you claim for it, but there is one great defect in using bullet-firing machine-guns; you cannot tell whether you are hitting the mark or not. With a shell-gun you can see the shells explode and know just where you are." I asked them, "How do infantry know?" I am sure that a machine-gun has the best chance of the two. I said, "Bring out your shell-gun and I will take the Gatling, and we will have a try for 30 seconds at any guessed distance under 3,000 yards." They did not bring out the shell-gun, but they set up a mark for me, which I guessed to be about 2,200 yards. I set the stops on the elevating arc so the gun would oscillate vertically between 2,000 and 2,500 yards. I also gave it about 30 yards horizontal oscillation. I fired 500 rounds in the 30 seconds, and made 17 per cent. hits (target 6×20 feet). The movement of the gun was just like sprinkling water out of a hosepipe. I will leave you, gentlemen, to judge whether a shell-gun with its requisite number of men could do any better in the same time. Before I take my seat, I beg to deny that any such trial has ever been made with the improved Gatling gun positive feed before any North American Indian Chiefs, as stated by Captain Armit. Can you imagine a metallic cartridge hanging fire long enough to pass through a gun and drop on the ground before going off?

The CHAIRMAN: Before calling upon Captain Armit to reply, there are a few observations which I should like to make. I notice in the paper the lecturer says that there is rather an uncertainty as to the meaning of the term "machine-gun." I do not quite agree with him there, because I think a machine-gun is a gun without recoil, that when once you get your sights on you can keep on firing at your enemy as long as it is kept charged. That is the meaning of a machine-gun. Some are rifle-calibre machine-guns, and some are shell-guns, but that is the actual meaning of the words "machine-gun." He also speaks about the machine-gun, rifle-calibre, mounted as a field-piece with a limber. Captain Wilson, who gained the Victoria Cross in the Soudan, devised a method of mounting the gun on two wheels in very much the same manner as that shown by Colonel Alt. When we went up the Nile the other day we asked Captain Wilson's permission to mount our two guns in the same way. We left the limbers at Cairo; we took our guns on the two wheels. There was a light pole across the trail which Nos. 3 and 4 carried, and when we were near the enemy, the muzzle was always to the front; that is to say, at the word "Action!" 3 and 4 dropped the trail; the gun was immediately in action, and the feed was on the gun with the cartridges in it. As the arc of fire, or the points within which a rifle-calibre gun is useful, is only the range of infantry fire, it ought to be always in action at any moment, and therefore the questions of unlimbering, shifting your carriage, and getting the machine rifle-calibre gun into action, the same as you have to do with a field-piece, to my mind, do away with a great deal of its efficiency. I am delighted to hear from the branch of the Service

represented by Colonel Liddell that they are going to take up the machine-gun and try and use it on a galloping carriage. Some years ago Mr. Nordenfelt assisted me to mount the gun on a galloping carriage, so that the gun would train over the wheels perfectly clear, in other words, so that it was always in action, and I compared that gun very much to what a torpedo-boat is to us at sea. You may try to get it into position, and you may lose its detachment, but you only lose five men, and you only lose the gun. But look at the enormous amount of mischief which it can do, and how efficient it can be if once you get it into position! It is the same with the torpedo-boat. The probability is it will never get near the ship, but if it does get near the ship, it is a great nuisance to that ship. The question comes, after all, to this: How are we to mount these guns? Colonel Alt has mounted his gun in a most excellent way, and other mounts have been proposed. That is the real point we have to think out. I should like to tell you how we carried our guns in the Soudan. We carried them on four camels, each camel and each gun numbered, and each camel had so many men told off to it, all numbered and named. The blue-jackets called them different names, naturally, but they went by numbers in the book. No. 1 carried the barrels: No. 2 carried the training and elevating gear, the feed-plate, and the wheels; No. 3 carried the trail, which was very heavy (it was an iron trail supplied for the machine-gun); and No. 4 carried four boxes of hoppers full of ammunition. Of course we only got to Korti say on the Monday, and had to start on Wednesday morning. We had not much time to drill, but whenever we halted we had a little drill, say for ten minutes every night. We found that after the order "Halt!" we had to get our camels down—it took some time for the men to get accustomed to the camel, and the camel to the men; but from the order "Halt! mount the gun," we used to be able to form the order of march under three minutes, which was very quick considering we had to connect the elevating and training gear. I am not going to be impertinent enough, with so many soldiers present, to refer to what the tactical positions of these guns should be, whether they should be attached to the cavalry, the artillery, or the infantry; but I do most earnestly hope that all the branches of the Service will give them a thorough and fair trial. If I might suggest how I might work them if I was on shore, which I might be some day, I think I would divide them into batteries of four guns, for the simple reason that the battery of four is more distinctly under control than the battery of six. You would have a leader to each subdivision, and would always instruct them to work independently as skirmishers, and never in line either ahead or abreast. Sir Redvers Buller says that these guns are useful in defence but not in attack. I think they would be useful in attack, particularly as an adjunct to the cavalry, mounted on a galloping carriage. However, I am sure that nobody here will think me egotistical in referring to a fight that we had on a steamer in the Soudan. That was a distinct attack. We were in a steamer that could only go two knots against the stream. The range of the guns in the fort that we attacked was about 3,000 yards. It was a low fort, very difficult to hit, but fortunately it had embrasures. We had our two guns mounted *en échelon*, so that they would fire both broadsides clear. We went up to that fort, and although there were hundreds of riflemen on the bank, and the natural thing for the men to do would have been to fire at the riflemen, what we instructed them to do was to keep pumping lead into the fort, and the consequence was they could not hit us with their shot. The hail of lead prevented them hitting the steamer. We passed within 80 yards of those three guns, and they could not fire at us. As you know perfectly well, it was a sort of penny-boat really, very thin, worn out, like one of the boats on the Thames here. The proof of what I am saying is this, that there was a moment when the two machine-guns would not bear, and at that particular moment, only some 200 yards after we passed the fort, when we were giving three cheers, thinking that we had done a very fine thing, and when the machine-guns would not bear, they hit us two or three times, and one shot went into the boiler. It was therefore a distinct case of attack, and it is to the attack of those two machine-guns, in my opinion, that we owe our lives, and not only ours but those of Sir Charles Wilson and his party. I think if we had had only one machine-gun, we could not have played on the fort with the same effect that we did. I do not think any of us would have come back; in fact I may say I

am certain that neither Sir Charles Wilson nor any of his men nor ours would ever have got back. I mention this to show what I myself think of the machine-gun, for attack. Sir Charles Wilson might have marched down the bank, but he had three very strongly fortified villages to pass, and he had only twenty English soldiers. He had also 200 of those men who really wished to get back to the Khartoum which they had left.

Admiral FREMANTLE: Were those Gardner guns?

The CHAIRMAN: Yes.

Admiral FREMANTLE: What has your lordship to say about the feed of the Gardner? It is open in front.

The CHAIRMAN: I do not like that feed nearly so much as the Nordenfelt feeds but my own experience is that you can make better practice and keep on firing better with the horizontal lever than you can with the rotary motion. The rotary motion, especially with a gun mounted light, throws it out of gear every time, so that it ceases to be a machine-gun. In other words, you have to keep on relaying it almost every time. The gun is too light for the strain on the lever. With the Nordenfelt gun that does not occur at all. I have such a firm belief in these guns myself, that I have used all the energy I have to try and get them forward, and my efforts have been very well backed up by many very distinguished men in the sister Service. The artillery, I am very glad to see, are coming forward, and as to the cavalry, we have a Colonel with us to-night who says that he will try his best. Lord Wolseley also has given them a very great immediate future. I have heard him say myself that any European army that will have these guns, with thoroughly drilled men, and with smokeless powder, is certain to win the victory in the next war. That is a very strong opinion from a very eminent man. I can only say, as far as I am personally concerned, I have such faith in them that I would to-morrow rather command six batteries of these guns on shore than I would the finest iron-clad in the Navy with a chance of a brilliant action.

Captain ARMIT: Replying to the remarks that you have been good enough to make upon my poor endeavour to bring the machine-gun before you, allow me to state that I desire, in the first place, to make no aspersions on either Sir Frederick Campbell, who has been called an obstructionist, and who has a will of his own—we all know that—or the Machine-gun Committee, presided over by Admiral Boys. I was at Shoeburyness, and saw and heard certain things and drew certain conclusions from what I saw and heard, but I am very glad to hear to-night that those conclusions are incorrect.

My argument is that all guns should have a fair trial in the Service, and that Officers who have to use these guns, and risk their lives in the defence of their country, and those guns, should be allowed to decide which they would prefer to use in action. I think Captain Acland has rather misunderstood me. I wanted to impress upon you that in my opinion when the country goes to war the Service should have one arm to defend itself with in every branch of the Service, that it should not have a dozen different systems and types of machine-guns, a dozen different drills on board each ship, or in the field, and I perfectly agree with Captain Acland that you may try every one of them in peace time, but you should be prepared, before you go to war, to arm the Service at all points thoroughly and well, and not to have a multiplicity of arms and drills, such as will render the ship a regular Tower of Babel, because in a ship, as well as in a regiment, a battalion, or corps, if you have such a number of drills, arms, and ammunitions to serve, you may have the wrong ammunition up at the wrong time and in the wrong place. With regard to Colonel Alt's remarks, of course I shall be very careful in what I say, as he is my Commanding Officer. Allow me, however, to say that the explosion I referred to at Aldershot was an explosion that took place at Whitsuntide, in the presence of Sir Archibald Allison, and they were ball cartridges that exploded. It was not so much the fault of the gun as of the ammunition, which, by being carried about in the limber carriage, gets knocked about; the bullets, loosened, allow an air-space between them and the cartridge case, and the flame of the cartridge exploding by being suddenly extracted before it has actually been fired, may explode others in the hopper, as it appears to me was the case in our explosion. As to the American hang-fires not exploding on the ground, I derived my information from a Lieutenant of the American Navy, and

also from a Commodore, both of whom said they were present and saw it happen. Mr. Accles, the agent of the Gatling Gun Company, says that it never did happen, and therefore I can only conclude that my friends were mistaken. I must mention that Captain Wilson, V.C., inspected our guns at headquarters. He inspected Colonel Alt's carriage with the present Director of Naval Ordnance after El Teb and Tamaai, and designed his two-wheeled magazine carriage after having seen Colonel Alt's carriage. I was present when the Director of Naval Ordnance visited our headquarters. I had the men with the carriages before him, and that was long before any such carriages were introduced into the Navy, and Admiral Hopkins states that it was entirely to Colonel Alt that we owed the introducton of this carriage into the Service. With regard to Lord Charles Beresford's experience of machine-guns, I must at once submit that his having used them in action is far better than my having simply seen the old Montigny used in action, and also I would remark that I regard machine-guns myself, and my paper will show it, as being as useful at times in attack as they are in defence; but, on the whole, I regard the rifle-calibre machine-gun as a defensive weapon more than an offensive one, while I regard the shell-firing gun as an offensive weapon rather than as a defensive weapon. Allow me, in conclusion, to thank you all for the kind manner in which you have received my paper, and to thank Lord Charles Beresford for his great kindness in presiding on this occasion.

The CHAIRMAN: I hope you also will allow me to thank Captain Armit in your name for his very able and interesting paper.

A MACHINE-GUN BATTERY AND ITS EQUIPMENT.

(Communicated by Lieutenant G. E. BENSON, R.A.)

I.—*Employment of Machine-Guns in a Battery.*

MY experience of machine-guns is not very extensive, having been chiefly acquired in the Suakin Expedition of this year; during this time I was attached to the Royal Marine Artillery to assist them in forming a Gardner gun battery drawn by mules on field battery lines, and for the short time I served with this battery ample opportunity was afforded me for thinking over the question of machine-guns and their use, and of watching their effect in the field, with a view to find out the best tactical use that can be made of them in future campaigns; and from what I then saw I feel convinced that a great field is open to them, provided that in future they are equipped in a manner more suited to their powers.

Machine-guns have not hitherto been given the same chance as field-guns; for, when more machine-guns than one have been employed in the field, they have as a rule been separated; so, if one got out of action either from being disabled or jambed, the consequences were serious at that point simply from the fact of its not having the support of other guns. One might as well separate a battery of field-guns by sending each gun to a different place to fire at different objects; for, as I will afterwards point out, machine-gun fire partakes more of the nature of artillery shrapnel fire than of infantry fire.

The formation of the Gardner guns into a regular battery in the Suakin Expedition is no doubt a great step in advance, yet in my opinion it is only *one* step, for the real value of machine-gun fire depends on the rapidity with which they can be moved up and brought to act on any desired point of the field of battle. The only occasion on which the Gardner battery came into action against the enemy when it was not in a defensive position in a zareba, was in the action at Hasheen on March 20th, 1885, on which occasion the guns were run out at the left rear corner of the Guards' square, and opened fire into the scrub at 200 to 300 yards range, whence some of the enemy were annoying us by their fire. After a few rounds the enemy were silenced. Again on the retirement of the force later on in the day the battery was ordered to go outside the square and assist to cover the retirement. This we did by coming into "action rear" on the flank of the square, and firing at the enemy till we were left 30 or 40 yards in rear; then we limbered up, and hurrying along (the men being dismounted we could not go very fast) came into action again on the flank of the square. The enemy at times followed us at a distance of 300 to 400 yards, but did not show themselves much in

the open, except at a much longer range; however we continued our fire as long as we saw them.

Our fire was much hampered by the necessity of limbering up almost immediately after the square passed us; for, as our men were unmounted, we could not retire much faster than the infantry, thus we could never remain long enough in action to make our fire really effective.

If the guns had been drawn by horses, and the gunners mounted on the carriages, we could have taken up each successive position much more rapidly, and it would have been safe to remain longer in action after the square had passed us, thus the whole time of remaining in action would have been increased and the effect of the fire much greater.

At Tamai, the Gardner battery was left with one infantry battalion to defend the zareba, so did not have a chance of coming into action; but as I accompanied the advance on that day, I took note of occasions when the battery might have been employed with advantage.

Several parties of the enemy were firing at us at distances of from 700 to 1,500 yards, and I feel sure that once the range were found (as it speedily would be) a shower of bullets from the machine-gun battery would have silenced those parties that were beyond the limit of infantry *aimed* fire, much sooner than it could be done by the *unaimed* infantry fire.

The affair at Hasheen on the 20th is almost the only occasion, I believe, in which machine-guns have been used as a battery acting independently; and this, I take it, is the proper way to employ them. It is all very well to place them to sweep defiles, or at the salients of redoubts when occasion requires; but by confining them to those uses the principal advantage of machine-guns is lost, viz., their mobility. Now, when drawn by mules with the detachments marching alongside, they still cannot move faster than infantry, and (as happened at Hasheen) neither dare they trust themselves far from infantry, nor can they change position with anything like sufficient rapidity to make the most of their fire; for, of course as with artillery, the more time spent in taking up a position, the longer they are out of action and valueless.

The action of machine-guns, as I said before, partakes more of the nature of artillery shrapnel fire than that of infantry fire for the following reasons:—

1st. The fire of a battery of machine-guns being aimed by only one picked man per gun is immediately under the control of the Commanding Officer of the battery, who can at will turn his stream of bullets on any spot within 1,700 yards, and form a zone of fire in which no troops could live, just as a battery of artillery sends a smaller number of bullets a greater distance by means of shrapnel shell.

2nd. Infantry aimed fire ceases at 900 or 1,000 yards, while machine-gun fire can be aimed and under control up to 1,700 yards at least.

3rd. Infantry fire, necessarily from its extended front, cannot be directed on one special object so easily, and in individual firing (from nervousness, bad shooting, &c.) a very large proportion of bullets must go astray; while machine-guns like field-guns have no nerves, and their bullets never fall very far apart.

4th. Machine-guns can have the mobility of horse artillery, as before mentioned, if properly equipped.

At Suakin, about the end of March, we had some target practice with the four five-barrelled ·450 bore Gardners which we were then using, and the results I think are worth noting here.

The target was a canvas screen 4 feet high and 10 yards long, and we opened fire at what we guessed was 1,050 yards, a range at which infantry fire is no longer aimed. After a few rounds we saw, by the amount of dust knocked up in front of the target, that our range was too short, and increasing the elevation to 1,100 yards fired about eighty rounds per gun. We then limbered up, retired, and came into action at 1,200 yards, when we again fired about eighty rounds per gun. I then rode up to the target, and was surprised to find it literally riddled with bullets. There wasn't a place where a man in any position whatever could have escaped. We afterwards advanced nearer, to about 800 or 900 yards range, and after a few more hundred rounds per gun the target was practically cut to pieces. It was unfortunate that on this occasion we could not try the guns at a longer range than 1,200 yards. The great fire effect at 1,100 and 1,200 yards range is of course due to the combined action of the four guns under one man; and though there were several jambs, caused by the extractor pulling the base of the cartridge off, the other guns kept up the fire while a jamb was being remedied. It was discovered by the Marine Artillery that the best method of rectifying a jamb of this description was by putting a pared bullet in the muzzle of the jambed barrel (just small enough to go down) and pushing it down with the cleaning rod so as to catch the edge of the cartridge case and force it out. But our object in the future is to have a machine-gun which will never jamb. It is only with a view of suggesting the manner in which they should be employed when perfected that I write these pages.

II.—*The Equipment of a Battery.*

On the return of the force from Tamai, we took over four of the new two-barrelled ·450 bore Gardners sent from Woolwich (sufficient men not being available to man the six provided), but unfortunately during the time I remained with the battery we had no brush with the enemy to test their efficiency in the field, so that my experience of these new guns is small. I hear, however, from an Officer who fired several thousand rounds out of them at Shoeburyness, that they never jamb.

The points I noted about their equipment which might be improved on are as follows, viz.:—

The axis of the gun is too high above the ground (about 4 feet); this entails less effective fire at short range, for in sweeping a plain or glacis, the bullets leaving the bore 4 feet above the ground would have a trajectory in a range of 300 yards which would go over the head of a man 200 yards distant. If the axis of the gun were only 3 feet 3 inches from the ground, the highest point of the trajectory would be 9 inches nearer the ground, and the fire would be more effective and sweeping. The great height of the gun causes another important defect, in that it entails the No. 3 of the detachment (who feeds the gun) having to stand on a step to reach the top of the feeder during the time the gun is in action; he thus forms a most conspicuous object for the enemy to fire at. It would be better too, if it could be so arranged, for the feeding number to stand in rear of the axletree instead of in front, and for a folding shield to be fitted on the axletree for his protection. This would reduce his exposure to a minimum. For savage warfare this of course is not so important, as savages are seldom good marksmen.

It struck me, and the same idea was shared by every artillery Officer at Suakin who saw the new guns and their equipment, that the carriages were a great deal too heavy for the guns. The trails and axletrees especially (both E. O. C. and R. C. D.) appeared almost strong enough to withstand the recoil of a 9-pr. gun. Of course, with machine-guns there is no recoil which causes any strain worth mentioning either on the trail or axletree, so all that is required is a trail strong enough to sustain the strain of draught over rough country, and an axletree strong enough to carry the gun and fittings (and men if mounted on axletree seats) under the same conditions.

The traversing and elevating gear appear perfect and are a great improvement on the gear of the five-barrelled guns we used at first.

I will now proceed to give my ideas in detail as to the best method for equipping a battery of machine-guns.

The battery might consist of either four or six guns. The advantages of a four-gun battery are, that it would be handier and would seldom have to be split up on the battle-field. It is also a convenient number to put into a redoubt if used for passive defence. On the other hand the men required to man four guns would barely be sufficient to carry on the ordinary guard and picket duties of a battery. Of the *matériel* let us first consider the gun-carriage and limber. For these I suggest the following figures:—

Axis of gun 3 feet 3 inches to 3 feet 6 inches above the ground.
Wheels 4 feet 8 inches diameter.

Track 5 feet 2 inches (as in present carriage).

The axis of the gun might be lowered by means of crank in the axletree, also by reducing the height of the "crosshead" on which are the elevating and traversing gear. Axletree boxes with guard-irons, &c., for seats to be provided, each box to hold 500 rounds of ammunition in holders. Thus a thousand rounds would be immediately available in case of sudden attack.

The gun, filled axletree boxes and fittings complete, would weigh about $4\frac{1}{2}$ cwt. A folding shield might be added to each axletree box to protect the gunners when in action, this would make the total weight to be supported by the gun axletree about 5 cwt. The feeding should be done from the rear of the axletree; to do this the gun would have to be set a little further back in the carriage at the expense of making the point of the trail a trifle heavier to lift. The arrangement for keeping the barrels cool would be the same as in the present two-barrelled Gardner, as would also the admirable plan by which the feeder is always kept secured to the gun.

The limber might be similar to the present one, except that I would recommend the limber-box to be make longer and narrower, and fitted with guard-irons and hand-straps in order to seat two gunners; the box should hold at least 3,000 rounds in holders, as in the present carriage.

The spare part box should be carried on the wagon to lighten the load for the gun-team to pull as much as possible.

The weight of the limber-box packed, together with intrenching tools, would be about $4\frac{1}{2}$ cwt. The gun-carriage, and limber stripped, should not weigh more than about $11\frac{1}{2}$ cwt. This would make the whole weight of the gun-carriage, and limber packed, about 21 cwt. With four gunners mounted the total weight ought not to exceed $26\frac{1}{2}$ cwt.,—a load which four horses would be able to drag quite as fast as Horse Artillery.

For the carriage of ammunition I think one wagon per gun, fitted up much in the same way as an artillery ammunition wagon, would meet the usual requirements. On the wagon limber would be a box containing 3,000 rounds in holders as in the gun-limber. On the wagon body there might be two boxes, each with 2,000 rounds in holders, while the spare part box might be carried on the footboard. All the ammunition boxes should be fitted with guard-irons and hand-straps for seats. The weight of the ammunition boxes filled on the wagon-limber and body, together with the intrenching tools and spare part box, would come to about 11 cwt. Allowing 12 cwt. for the stripped wagon-limber and body, the weight of the wagon packed would not exceed 23 cwt., which with four gunners mounted would become $28\frac{1}{2}$ cwt. This also could easily be drawn by four horses.

The sergeants and coverers of each gun would be mounted on horseback.

The weights I have allowed for the stripped carriages in the above estimate may seem too low to some people, but it is my opinion that in this age when steel is so extensively used there would not be any difficulty in keeping the weights below those estimated, viz., $11\frac{1}{2}$ cwt. for the stripped gun-carriage and limber, and 12 cwt. for the stripped wagon body and limber.

The following would be the war strength of a battery of machine-guns equipped as above :—

Officers and Men.

	Four-gun battery.	Six-gun battery.
Majors	1	1
Captains	1	1
Subalterns	2	3
Sergeant-major	1	1
Quartermaster-sergeant	1	1
Sergeants	4	6
Corporals	4	6
Bombardiers	4	6
Gunners	28	42
Drivers	34	42
Trumpeters	2	2
	82	111
Artificers—		
Farriers	1	1
Shoeing-smiths	2	3
Collar-makers	2	2
Wheelers	2	2
Armourers for machine-guns	1	1
Total Officers and men	90	120

Horses.

	Four-gun battery.	Six-gun battery.
Riding—		
Officers	6	7
Staff sergeants	2	2
Other N. C. O.'s	8	12
Farriers	1	1
Shoeing-smiths	1	1
Trumpeters	2	2
Range-finders	2	2
Spare	3	4
	25	31
Draught—		
Guns	16	24
Wagons: Ammunition	16	24
Wagons: Forge	6	6
Wagons: Store	4	4
Wagons: Ammunition and store	12	12
Spare	6	8
Total horses	85	109

For the sake of comparison I may state that—

	Men.	Horses.
The war strength of a R.H.A. battery is	182	183
The war strength of a 9-pr. or 13-pr. F.B. is	175	132
The war strength of a machine-gun battery of six guns	120	109

The amount of ammunition carried per gun with the battery would be :—

	Rounds per gun.
In the axletree boxes..............	1,000
In the gun-limber box	3,000
In the wagon-limber and body......	7,000
Total........	11,000

These numbers are calculated from the amount of room the cartridge-holders for the Gardner gun take up.

The supply of ammunition would be kept up in the field by S.A.A. carts from the ammunition column, each carrying nearly 10,000 rounds in the service S.A.A. boxes.

The empty holders would be refilled from those boxes by the spare gunners while the battery was in action.

The front of this battery in action would be calculated at 15 yards interval between each gun.

If the number of men and horses in the above estimate be thought too extravagant it could be reduced by substituting for the wagons, six two-wheeled carts similar to S.A.A. carts, but fitted to carry 7,000 rounds of ammunition in holders. This arrangement would effect a saving of six drivers and twelve horses, bnt on the other hand the carts would not possess the mobility of the wagons nor could the spare gunners be mounted on them, and the efficiency of the battery would thereby be impaired to a certain extent.

Lord Charles Beresford has recommended a carriage for machine-guns which will enable the gunners sitting on the trail to keep up a fire in the act of retiring. This I do not think feasible, for these reasons: in the first place it seems to me that the difficulty of feeding the gun when in motion would be insurmountable; and secondly, the motion of the gun going over any but the most level ground would cause the bullets to fly anywhere but in the required direction. If the gun were in danger of being captured while in the act of retiring, it could be better defended by the carbines or revolvers of the detachment than by its own fire, wild and uncertain as it would be under the circumstances. Again, when firing limbered up at the halt the least motion of the horses would throw the trail out, while the time saved by not having to limber up before retiring would be inappreciable. Moreover, by remaining limbered up when in action the limber and horses would be very much exposed and would increase the size of the mark for the enemy's fire to a very great extent.

The only point to be decided on in forming such a battery is the

nature of the machine-gun to use; that question I will not discuss at present beyond saying that if the accounts that have reached me of the performance of the new Maxim gun are correct, there is very little doubt but that this will be the machine-gun of the future. The gun being so light (only 60 lbs.), two of them might be mounted on the same carriage and worked together by the same elevating and traversing arrangement, in fact becoming to all intents and purposes a two-barrelled Maxim gun.

A machine-gun battery, such as I have endeavoured to describe above, could be used in numberless ways in a campaign, and I think it would be especially useful in accompanying cavalry in order to drive away any bodies of infantry before which the cavalry would otherwise have to fall back. When it could get within 1,700 yards of the enemy's artillery it would speedily put a battery out of action before sustaining serious damage itself, while in defending a position against an infantry attack it would be invaluable, combining by its mobility great powers for counter-attack as well as for passive defence.

It is sincerely to be hoped we shall not be behindhand in giving the latest machine-guns a fair trial, equipped in a way suited to their tactical powers, and that it be done in time of peace, so that if war should break out, batteries of machine-guns would be ready for service completely efficient both in their equipment and in the training of the men and horses.

Mhow, Central India,
June 10th, 1885.

Friday, January 15, 1886.

Colonel G. H. MONCRIEFF, Commanding Scots Guards, in the Chair.

THE TRANSMISSION OF DRAWINGS BY SIGNAL.

By Alexr. Glen, Lieutenant 14th Middlesex (Inns of Court) R.V.

In this paper I propose to explain a system which I devised and have elaborated in conjunction with my brother Officer, Mr. Willink, and with the assistance of the signallers of our corps, the Inns of Court Volunteers. The object of the system is that one person who has the means of communicating with another by telegraph, heliograph, lamp, flag, or other mode of signalling, may enable the recipient of the signals to make a facsimile of any drawing which may be in the hands of the sender. The drawing may be of any kind, from a rough sketch or plan to a photographic likeness or a chromolithograph. The accuracy with which the drawing is transmitted may be increased to any extent that the sender may think fit; while the scale on which the facsimile is drawn is at the discretion of the recipient.

The important question, however, is the practical application and utility of the system. On this question, as a volunteer, I can only offer a few crude suggestions, and leave it to be discussed, as I hope it will be, by those who have experience of the requirements of the Service.

When I was attending the School of Instruction in Army Signalling at Wellington Barracks in 1883, the District Signal Officer, Lieutenant-Colonel Bonham, remarked that army signalling was in its infancy, and comparatively undeveloped, and that he thought that it was a subject in which volunteers had the opportunity of doing service to the Regular Army. It is, I think, to a great extent a result of that remark that I have this paper to read to-day.

The idea of transmitting a drawing by the methods of army signalling originated in my case in a little scheme that I carried out on the march to Portsmouth for the Easter Review of 1884. On the Good Friday morning there were to be some small manœuvres in connection with the pursuit of a convoy that was to start southwards from Petersfield. I was in charge of the Inns of Court signallers, and leaving Petersfield at an early hour with one signalling party, we took up a station on Butzer Hill, with the object of signalling the movements of the convoy to the other party, whom I had stationed at Petersfield. With the Petersfield party I had left a number of small tracings from the ordnance map of the neighbourhood, with instructions to mark the points referred to in any message received from me

on one of the tracings, and to pin the tracing to the message form. This was carried out, but I soon found difficulty in expressing shortly, and at the same time accurately, the exact positions of the convoy and its escort, with reference to the Ordnance map which I had with me. It occurred to several of us independently that the simplest way of overcoming this difficulty would be to draw vertical and horizontal lines in corresponding positions on the map and the tracings, and to letter the spaces between them.

The positions of the shot marks on the targets in an Anglo-American rifle match shot at Wimbledon had previously been transmitted by cable across the Atlantic in a somewhat similar manner, except that, I believe, short words were used to indicate the different spaces into which the diagrams of the targets were divided, instead of merely letters.

From signalling single points to be marked on an existing map or copy it was but a short and almost obvious step to dispense with copies of the original map, and to transmit the position of roads, fences, houses, and the like in addition to other information. It is only, however, after innumerable experiments and practical trials, during the latter part of 1884 and the beginning of 1885, that a series of rules has been formulated, by which not only military sketches but recognizable likenesses have been signalled. Before I conclude this paper I will refer to some of the drawings to which the system has been applied.

I must mention that on submitting a copy of the rules in their then condition to the War Office, through Colonel Moncrieff, who kindly interested himself in them, I ascertained for the first time that Lieutenant-Colonel Melville, R.E., had already submitted an apparatus, which I subsequently learned he had patented in April last, to be used for the purpose of transmitting drawings or marks on a drawing by signal.

The following are the terms of his specification :—

"It is often convenient to be able to communicate by telegraph or telephone, or generally by signal, from a distance, information as to localities and positions when there are no means of transmitting plans. My invention relates to a method and apparatus for producing, according to signal, copies of plans or other marks, the like method and apparatus being also applicable for communicating by cypher.

"For this purpose I provide, at each of the two stations which have to communicate, a board or frame which is graduated along the side by distinctive numbers or letters, and which has fitted to it a graduated rule which can be slid, guided parallel to itself, along the board or frame. Assuming that a plan or sketch existing at the one station has to be reproduced at the other, the sending operator slides his rule along the plan to some point thereon and signals the two numbers, letters, or marks which indicate that position, the one number, letter, or mark signifying the position of the rule, and the other the position of the point relatively to the rule, in other words, they indicate the co-ordinates of the point. The receiving operator moves his rule and marks a point according to the signal. Thus by

orm.
rtly,
and
me.
y of
ntal
d to

glo-
ans-
ner,
rent
tead

p or
pies
nces,
nly,
ring
s of
but
this
has

then
ndly
tieu-
tus,
used
; by

h or
s to
ting
ing,
hod

nich
the
it a
the
one
ides
two
one
the
rds,
ator
by

Fig. I.

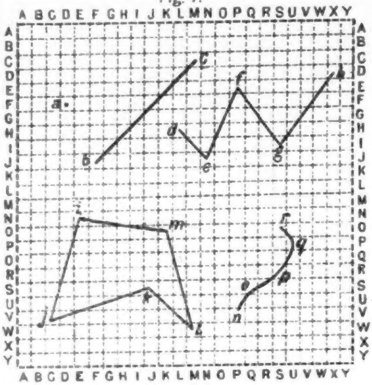


Fig. II.

ZAA	ZBA	ZCA	ZDA
ZAB	ZBB	ZCB	
ZAC	ZBC	ZCC	
ZAD			

Fig. III.

AZA	BZA	CZA	DZA
AZB	BZB	CZB	
AZC	BZC	CZC	
AZD			

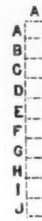


Fig. VI.

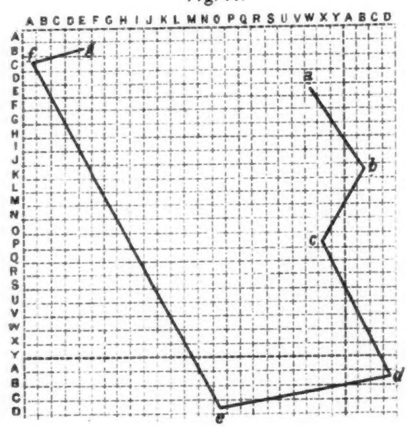


Fig. VII.

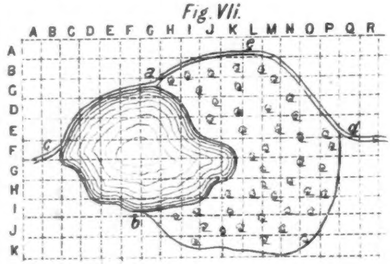


Fig. VIII.

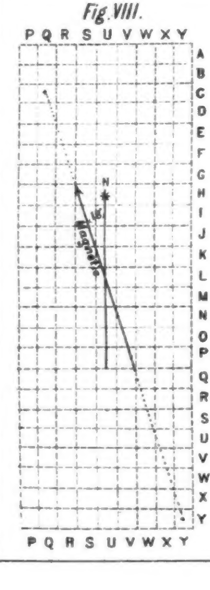
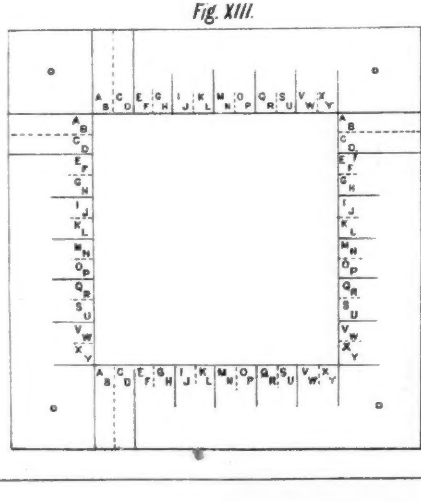
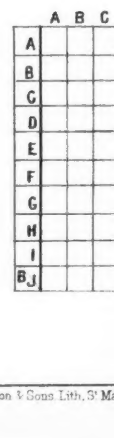


Fig. XIII.





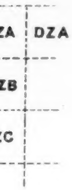


Fig. IV.

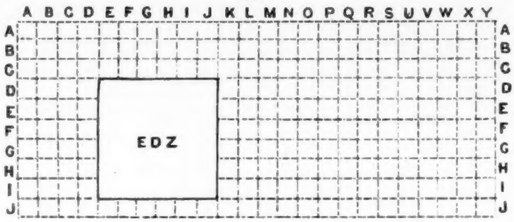


Fig. V.

I	J	K	L	M
Y	A	B	C	N
X	H	Z	D	O
W	G	F	E	P
V	U	S	R	Q

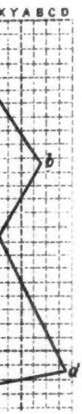


Fig. XI.

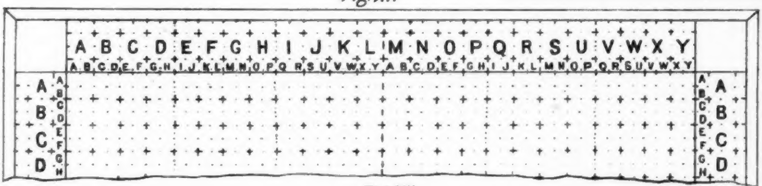


Fig. XII.

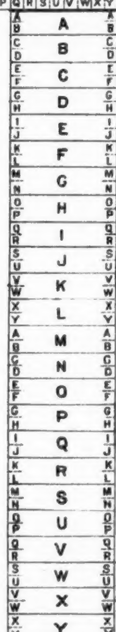
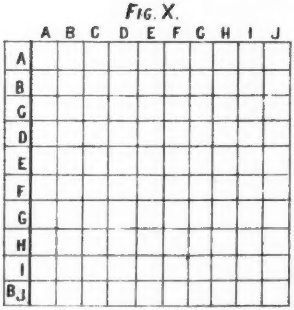


Fig. IX.

Numbers	Miles.		Yards.
0	O	Z O	O Z
1	P	Z P	P Z
2	Q	Z Q	Q Z
3	R	Z R	R Z
4	S	Z S	S Z
5	U	Z U	U Z
6	V	Z V	V Z
7	W	Z W	W Z
8	X	Z X	X Z
9	Y	Z Y	Y Z

Fig. X.



NOTE.

Fig. IX.—Angular measurements may be represented in like manner with the help of the letter **T**, that letter being placed before the first digit in order to represent the number of degrees in an angle measured (from the magnetic north eastwards, unless otherwise stated), in a horizontal plane, and being placed after the last digit to represent an angle measured (from a horizontal line upwards), in a vertical plane. The "**T**" may be doubled for the purpose of indicating that the angle is measured to the west (in a horizontal plane), or downwards (in a vertical plane). Thus "**TQ W O**" or "**TTY O**" would denote "due west," and "**R U UT**" or "**UUT**" would denote "sloping 5° downwards.

Fig. XI.—The small letters and the dots in this figure should be in red.

Fig. XII.—The small letters should be in red.

...son & Sons Lith. St Martins Lane W.C.

sig
sen
poi
det
the

acc
sev
dr
to
co
we
we
m

m
I

th
a

th
s
s

i
l
s
a
i

signalling the co-ordinates of a number of points on the plan at the sending station and the character of the localities with which those points correspond, the sender enables the receiving operator to determine corresponding points, and to sketch a plan corresponding to the original.

"In like manner, other designs or marks could be reproduced according to signal, and cyphers might also be communicated in several ways. For example, a message might be sent as a sketch or drawing with a number of its points marked by the sender according to letters or marks reckoned from some predetermined origin of co-ordinates, and the receiver, subjecting this sketch to his frame, would be able to read the same letters as those by which the points were determined on the sketch, and could thus decypher the message.

"Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is—

"1. The herein described method of producing copies by signal, that is to say, by signalling co-ordinates of points from one station, and marking these points at another.

"2. For producing copies by signal or communicating by cypher, the use, at each of two communicating stations, of apparatus consisting of a board or frame graduated along its side and a graduated sliding rule adapted thereto, substantially as herein described."

I understand that Lieutenant-Colonel Melville has formulated instructions and suggestions for the use of his apparatus; and I hope that he will give the Institution the benefit of his views on the subject of this paper.[1] His specification, instructions, and apparatus, and our system, which has since been considerably amended and improved, have both, I believe, been tried and reported upon at Aldershot, and I understand that they were afterwards sent to the Staff College.

No apparatus beyond paper and pencil, and some strips cut from the paper and marked in the manner hereinafter to be described, is absolutely necessary for converting the drawing into a message capable of being signalled, or for reproducing the drawing from the message, by our system; but for convenience, and in order to save time, we use sectional paper, that is, paper with faint equidistant lines ruled upon it vertically and horizontally, and certain instruments which will also be described presently.

A plan might possibly be signalled in the course of time by merely giving the co-ordinates of points in connection with explanatory sentences, but the message would be of such inordinate length as to be practically useless. In order to bring the message within a reasonable compass, we have by degrees settled a number of rules, which I will now proceed to explain with the help of the diagrams.

Columns and Rows.—The drawing is divided by actual or imaginary lines into columns of a certain breadth, and into rows of the same

[1] For further particulars, see pages 90—91.—Ed.

breadth, at right angles to the columns. First, suppose the drawing to be square and to be divided into twenty-four columns and the same number of rows, and the columns to be marked as in Fig. 1 with the letters of the alphabet (omitting T and Z) from left to right, and the rows to be marked in like manner from top to bottom.

Points.—Any point on the drawing may then be denoted with a degree of accuracy depending on the breadth of the columns and rows, by a group or pair of letters, namely, the letter marked on the column in which it appears, followed by the letter marked on the row. Thus in Fig. 1 the point *a* is denoted by the group "DF."

Straight Lines.—A straight line joining two points is denoted by joining in one group the two pairs of letters which denote those points. In Fig. 1 the straight line *bc* is denoted by the group "FJMC."

Bent Lines.—A line passing through a series of points, such as the line *defg* in Fig. 1, is denoted by the series of groups which denote those points; and in order to distinguish the line from a number of detached points, the letter T is used. It will be remembered that this letter is one of those which are omitted from the alphabets placed round the square. It is placed at the beginning of the first group of the series and at the end of the last. Thus the line *defg* is denoted by the series "TLH, NJ, PE, SI, XDT."

Enclosed Spaces.—It is important to save letters and shorten the message when possible, and if the line eventually reaches the point from which it started, so as to enclose a space, the pair of letters denoting that point may be omitted from the last group of the series, leaving the letter T standing alone. The figure *ijklm* may therefore be denoted by the series "TEN, CV, JS, MW, KO, T," the single T being used instead of "ENT."

Curved Lines.—A curved line is denoted by indicating as many points in it as the degree of accuracy required may demand. For instance, the series "TPV, QS, SR, UP, SOT" denotes the curve *nopqr* sufficiently closely for the purposes of a sketch.

Degrees of Accuracy.—The accuracy of a drawing reproduced from the signalled messages, as compared with the original, depends on the breadth of the columns and rows. For a rough sketch, or for the less clearly defined features of a map, the breadth may be a $\frac{1}{4}$ inch. Generally $\frac{1}{8}$ inch will give sufficient accuracy, but if great accuracy be required the breadth should not exceed $\frac{1}{16}$ inch, while for photographs I have used columns and rows of $\frac{1}{32}$ inch in breadth. For one part of the drawing columns and rows of one breadth may be used, and for another part columns and rows of another breadth, the proper prefix being inserted in the message when the change is made.

Prefixes for First Degree of Accuracy.—With regard to these prefixes (which form an essential feature of the system which I am describing), when $\frac{1}{4}$-inch columns and rows are used, and the drawing is larger than a 6-inch square, it is divided into as many 6-inch squares as may be necessary. Each of such squares will have its own prefix. At the commencement of the message, or on changing the degree of accuracy, or in certain cases when the drawing is very large, and the short prefixes to be mentioned presently do not suffice, the

prefix will consist of three letters, of which the first is Z, the second of the letters omitted from the alphabets placed round the squares. The other two letters of the prefix are determined according to the rule already given for denoting a point. Thus in Fig. 2,—

The prefix for the square at the upper left corner is ZAA.
" " next on the right of ZAA is ZBA.
" " " " ZBA " ZCA.
" " next below " ZAA " ZAB.
" " " ZBA " ZBB.
" " " ZAB " ZAC.

And in like manner any other square may be noted. If the drawing be not larger than a 6-inch square, the prefix ZAA will be given.

Prefixes for Second Degree of Accuracy.—When $\frac{1}{8}$-inch columns and rows are used the drawing is divided into 3-inch squares, and the prefix for each is the same as if it were a 6-inch square, except that the letter Z is now in the second place instead of the first. Thus in Fig. 3,—

The prefix for the square at the upper left corner is AZA.
" " next on the right of AZA is BZA.
" " next below AZA " AZB,

and so on.

Prefixes for Third Degree of Accuracy.—When $\frac{1}{16}$-inch columns and rows are used, the Z is put in the third place; but it would be inconvenient to divide the whole map into $1\frac{1}{2}$-inch squares, and this degree of accuracy is usually required here and there only, as for instance, in order to give the positions of the houses in a village which occupies but a small portion of the map. The two other letters of the prefix, therefore, refer to a column and a row belonging to a 6-inch square, and the $1\frac{1}{2}$-inch square is taken in such a position that its left side coincides with the left side of that column, and its top with the top of that row. The prefix for the $1\frac{1}{2}$-inch square shown in Fig. 4 is "EDZ," the proper prefix of the 6-inch square in which it is placed being given immediately before it, unless the message had been dealing with that 6-inch square, when $\frac{1}{4}$-inch or $\frac{1}{8}$-inch columns and rows were last used.

Short Prefixes.—It will not be necessary to give a full prefix of three letters when passing, without changing the degree of accuracy, from one square to a point in any of the eight squares which surround it, or in any of the sixteen squares which surround the eight. A single letter may be used to indicate a change from any one of these twenty-five squares to any other. The central square from which the first change is made is indicated by the letter Z; the eight squares surrounding it by the letters A to H, commencing with the square at the upper left corner of the central square, and going round it in the same direction as the hands of a watch; the remaining letters of the alphabet (omitting T) indicate the sixteen outside squares in like manner. The twenty-five squares in Fig. 5 are lettered in this way. In making the change from square to square

in the course of a message, the letter indicating the new square is always placed at the commencement of the first group, which denotes a point or line or a part of a line in such new square, except in the case of the letter Z, which must stand alone, in order that the group may not be mistaken for the full prefix of a 6-inch square. The succeeding groups of the message will have reference to the new square, unless and until a fresh change of square is indicated either in like manner, or by a fresh full prefix, or by the letter T standing alone and showing that a line which is being given returns to its starting point in some other square. The letters indicating the change of square will always have reference to the same central square until a fresh full prefix is given. An example of these changes is shown in Fig. 6, in which the line *abcdefg*, starting from *a*, is denoted by the series of groups "TWE, *D*BK, *Z*, XP, *E*DB, *F*OD, *Z*, AC, EBT."

By means of these long and short prefixes, the message may be made to travel over a drawing of considerable size without diminishing the accuracy with which each point is given.

Brevity of Message.—Accuracy is no doubt the most essential requirement in a system of signalling drawings. Brevity is the next. Attention has been given to this second requirement in the foregoing rules, but in order to obviate the necessity for inserting explanatory or descriptive sentences in the message, some further rules have been made.

Descriptive Words.—In the message words descriptive of the features of the drawing will apply to all groups which follow them, until fresh descriptive words are given which modify or supersede them. The repetition of descriptive words or sets of words may be avoided by denoting them by single letters (other than T or Z), the letter denoting the descriptive word or set of words being given by itself next after the word or set of words is given for the first time, and then in subsequent parts of the message being given alone without description. Or a code of descriptive expressions likely to be used might be arranged beforehand between the sender and receiver of the message.

Degrees of Light and Shade.—To indicate spaces covered with different degrees of light and shade, as in a photographic likeness, as many of the first letters of the alphabet may be used in place of descriptive words as there are degrees to be indicated, A indicating the absence of shade, B the lightest shade used, C a darker shade, and so on. For the shades of a photograph, it will be sufficient to use six letters, A to F. If the drawing be in several colours, the same letter will be used to indicate the corresponding shade of each colour that is mentioned.

Outlines.—Where an outline follows from one point to another a line already given in the message, a considerable saving is effected by omitting the groups denoting the intermediate points, and placing the letter T at the commencement of the group denoting the second of the two points. If more than one line between those points has been given, so that the omission of all the intermediate groups would create an ambiguity, then one or more of the intermediate points, preceded

if necessary by the letter T in like manner, must be given to indicate the course of the outline. For instance, if the wood shown in Fig. 7 has been given first, then in messaging the outline of the lake, after giving the point *a*, denoted (say) by the group "GC," it will not be necessary to indicate any points round the right hand side of the lake, but the next group after "GC" may be "TFI," the pair of letters "FI" denoting the point *b*; or if the outline of the lake had started from the point *b*, and passed through *c* to *a*, then the group "TT" would show that the outline returned to the starting point *b* along the edge of the wood, and not in a straight line from *a* to *b*. But in messaging the road subsequently to the wood and the lake, after giving "BF" for the point *c*, it will not be sufficient to give "TQF" for the point *d*, or it will be uncertain whether the road runs above or below the wood and lake. If a point such as *a*, denoted by the group "LA," be given, the two groups "TLA, TQF" will show that the road passes along the upper edges of the lake and the wood.

Size of the Drawing.—The size of the paper which the receiver of the message will require may be indicated by giving the full prefix of the square (6-inch, 3-inch, or $1\frac{1}{2}$-inch) whose lower right hand corner is at the lower right hand corner of the drawing. If the message is not commenced in that square, a second full or short prefix will have to be given.

Scale.—The scale of a map or plan may be given by stating at the commencement of the message, after the first prefix, the distance represented by an inch; and if this distance be given in miles, or as a fraction of a mile, it will be sufficient to give the number of the miles, or the fraction. For instance, in the case of a plan drawn on a scale of 40 feet to the inch, the words "forty feet" will give the scale; in the case of a map drawn on a scale of 20 miles to the inch, the word "twenty" will suffice; or if the scale be 6 inches to the mile, the word "sixth."

Points of the Compass.—Maps may be assumed, unless the contrary is indicated, to be drawn so that lines running upwards, parallel to the columns into which they are divided, represent the direction of the magnetic north. Where a map is not drawn in this manner, the direction of the magnetic north should be given immediately after the scale by a group or groups denoting a line drawn in that direction. If the direction of the true north instead of the magnetic be given, the word "true" must be added. If the columns run in the direction of the true north, it will be seen from Fig. 8 that the group "YYQC" indicates the direction of the magnetic north for this country, 18° west.

Direction of Motion.—The direction in which streams, troops, &c., are moving is indicated by the order in which points along that direction are given.

Numbers and Distances.—In an ordinary message, all numbers are required to be spelled out at length, in order to avoid mistakes; but inasmuch as the messages with which we are now dealing must be transmitted as cypher messages, a code may be used for numbers and distances, without introducing any greater risk of error than there is

in the other parts of the message. The letters O to Y (excluding T) may be taken to denote the ten digits, 0 to 9, but each digit must be sent as a separate word. The number which is given may be made to represent miles by putting the letter Z before, and in the same group with the first digit, or to represent yards by putting that letter after the last digit. The table in Fig. 9 gives these codes. Twenty-five miles will thus be denoted by the two groups, "ZQ, U," 1,500 yards by "P, U, O, OZ." If the sender wishes to indicate that the distances are only estimated, the letter Z may be doubled. Thus "ZZR" would mean "about three miles."

Writing the Message.—To facilitate the correction of errors, ten groups should be put in each line of the message written out from the drawing, and also in each line of the message taken down at the receiving station; and it will be convenient to use for message-forms pieces of paper, such as $\frac{5}{8}$-inch sectional paper, ruled with spaces for ten lines on each piece, and ten groups in each line, besides a margin for the date and other notes. The pages of the message, the lines on a page, and the groups in a line, may then be referred to by consecutive letters; A for the first page, for the first line on each page, and for the first group in each line; B for the second, and so on; so that any group in the message may be referred to by a group of three letters. The seventh group in the fourth line of the second page of the message would thus be denoted by the group "BDG," as in Fig. 10.

Collation of the Message.—In signalling the message it is essential that all groups, other than descriptive words, should be carefully collated, that is to say, that the receiving station should signal back each group as it is taken down at that station, in order that in the event of a mistake having been made, the group may be erased and signalled again. To indicate that a message represents a drawing, and is therefore to be collated in this manner, the preparative signal "CCC" may be given instead of the "CC" that indicates other cypher messages.

Correction of the Message.—If the message exceeds one hundred groups in length, the number of groups on each page should, if incorrect, be corrected before proceeding with the next page. With this object the sending station will give a succession of dashes at the end of the page: and at the end of the message, if this is not also the end of a page, will give a succession of dashes, followed by the three letters that denote the page, line, and group of the last group of the message. If the receiving station finds that it has the proper number of groups, it will give the general answer; if not, it will give "G." When the sending station thus finds that the wrong number of groups has been taken down at the other station, it will first give the initial letter of each line on the page, to be answered by the general answer where taken down correctly; otherwise by a second "G." This second "G" will show in which line a mistake has occurred, and the sending station will therefore go back to that line, and give the initials of each group of the line after the first, until a third "G" is given to indicate the exact place at which the mistake occurred. After this mistake has been corrected the initials of the

lines will be proceeded with unless and until "RT," signifying that the number of groups on the page is now right, or another "G" is given.

Verification of the Message.—The drawing may be reproduced as fast as the message comes in, unless it was messaged before the signalling commenced, and the message is signalled with great rapidity. The draughtsman may call first for the repetition, and then for the verification from the original of any parts of the message that he may have reason to think incorrect, by giving the three letters denoting the place of the group that he wishes to verify, preceded by the "IMI" (the ordinary signal for "repeat"), and afterwards giving "VY" (as an abbreviation of verify). Or if he thinks that part of his drawing has got into the wrong square, he may send "PX" (as an abbreviation of "Prefix)," and obtain a repetition of the group which took the message into the square in which the doubtful point is placed; but in this case the group thus repeated must be preceded by the three letters denoting its place in the message.

Reproduction of the Drawing.—The points denoted by the letters of the message will always be marked by the draughtsman in the centres of the proper columns and rows, in order that the maximum error due to the degree of accuracy that is being used may nowhere be exceeded. He should not round off the angles formed by the lines denoted by the message as he reproduces it, nor should he then attempt to blend together different degrees of light and shade; but this may be done subsequently, or on a tracing or other copy, if one is made, according to the nature of the feature of the drawing delineated.

Apparatus.—I have stated that no apparatus is absolutely necessary beyond paper and pencil, and such apparatus, if it can be so called, as may be readily made out of paper. But we have devised several instruments for our own convenience.

Transparent Square.—In order to read off a drawing into a message rapidly, I prefer to use a transparent square of horn, clamped to the back of a metal frame. The sides of the square are 6 inches in length, and the $\frac{1}{4}$-inch and $\frac{1}{8}$-inch columns and rows are scratched on the lower side of the horn, so as to come in contact with the drawing. The front of the frame is lettered in black for the $\frac{1}{4}$-inch, and in red for the $\frac{1}{8}$-inch columns and rows; so that when the square is placed upon the drawing the letters denoting any point with the first or second degree of accuracy are seen at once. The corners of the frame fit into the metal corners at the top, or those at the bottom of a small drawing-board in a sketching-case; these metal corners being placed at such a distance apart as to allow two 6-inch squares of the drawing to be messaged without shifting the paper.

A less durable form of transparent square consists of a square of tracing cloth, lettered and marked in the same manner as the frame and the horn. Sectional tracing cloth with the lines ruled on it can be procured, or a piece of sectional paper may be marked, and a tracing taken from it. In the latter case it is well to mark the columns and rows with small crosses in black, and spots in red, as in

Fig. 11; because if lines are drawn on the transparent square, they sometimes obscure lines on the drawing.

For messaging photographs we have used a transparent square of glass, with lines ruled on the lower surface with a diamond, and with the letters marked on paper gummed to the upper surface. This was in order to get columns and rows of $\frac{1}{32}$-inch in breadth.

Colonel Melville's Frame.—Instead of a prepared transparent square, the table or frame and sliding bar patented by Lieutenant-Colonel Melville may be used, if it is lettered in the manner above described, the sliding-bar being moved along from point to point as required.

Strips.—If a prepared transparent square, or a frame and sliding-bar, should not be available for converting the drawing into a message, strips of sectional paper ($\frac{1}{8}$-inch scale) may be lettered for the $\frac{1}{4}$-inch and $\frac{1}{8}$-inch columns and rows in a few minutes, as in Fig. 12.

We have had permanent strips made of white metal in the pattern shown in Fig. 13. If one of these strips, lettered from left to right, be pinned at the top and another at the bottom of a 6-inch square, the letters denoting any point may be found with the help of the third strip, which is lettered from top to bottom, and placed between and at right angles to the others, as in Fig. 13. If the drawing be upon sectional paper, the lower strip may be dispensed with, and the vertical strip pinned at the side of the 6-inch square.

If sectional paper be not available, a strip may be prepared by folding a piece of plain paper, so as to get a straight edge, and then marking off from a protractor or other scale, and lettering spaces of a $\frac{1}{4}$ inch and $\frac{1}{8}$ inch. If a protractor or scale be not available, a space of $\frac{1}{4}$ inch may be marked, as nearly as may be, on the edge of another piece of paper, and this may be used as a measure for marking off equal spaces on the strip. These spaces can then be subdivided by the eye with sufficient accuracy into spaces of about $\frac{1}{8}$ inch. The scale on which the drawing is made will then be communicated to the receiver by giving the distance between some two objects appearing on the drawing.

For reproducing the drawing from the message, the lettered strips are used in the same manner as above described; and much time will be saved by drawing upon sectional paper.

Hollow Square.—The transparent square and the strips above described are not lettered for the third degree of accuracy, which requires columns and rows of $\frac{1}{16}$ inch, because the $1\frac{1}{2}$-inch square divided into columns and rows of that breadth has to be placed here and there on the drawing as it happens to be required. For this degree of accuracy a flat piece of metal, wood, card, or paper, with a $1\frac{1}{2}$-inch square cut out of it, is used. It is only marked with $\frac{1}{8}$-inch spaces, because the position of imaginary lines dividing the $\frac{1}{8}$-inch columns and rows into columns and rows of $\frac{1}{16}$ inch can be accurately judged by the eye. The letters are marked round the edge of the square in the pattern shown in Fig. 14, two letters being marked in each space. The mode of fixing the position of the $1\frac{1}{2}$-inch square with reference to a 6-inch square has been already described. A hollow

square may be readily made from a piece of the sectional paper; but if sectional paper be not available, small strips must be prepared from plain paper, and used in the same manner as the larger strips.

That is our system as it at present stands. Our difficulty has been not only to construct a message which should accurately represent a drawing, but to enable the receiver of the message to ascertain quickly the exact places where errors, which are no doubt to some extent inevitable, have crept in, in order that he may at once call for corrections, and if necessary for the verification of the message, where he finds that something is wrong, without causing unnecessary repetition and delay. Improvements in this respect, and other rules tending to expedite the process and increase its accuracy will doubtless be devised from time to time, if the system be adopted for practical purposes; indeed we have been amending and making additions to the rules up to the time of the final revision of this paper; but the system as I have described it is capable of transmitting a map or sketch in a comparatively short space of time with as much accuracy as I take to be necessary for military purposes, if a reasonable amount of care be taken in making the message, signalling it, and working out the drawing.

For instance, we took the plan of the battle of Hasheen, which appeared in the "Standard" of the 8th April last, and signalled it by flag across Wimbledon Common. The copy which was reproduced by the recipients of the message seems as useful for all practical purposes as the original. The suggestion arising from this is that similar plans might be telegraphed with despatches for the purpose of explaining them graphically.

Again, we have transmitted in like manner the plan of a village prepared for defence, which is given at p. 197 of Colonel Brackenbury's "Minor Tactics." Colonel Moncrieff saw us signal by flag and reproduce about one-sixth of this plan in twenty minutes at our camp of instruction last summer. This suggests the possibility of transmitting by heliograph to a long distance an accurate plan of fortifications, or the preparation made for the defence of a position over the heads of an investing force. And it should be observed that if the cypher wheel, or any preconcerted arrangement of the letters of the alphabet were used, the plan could not be reproduced without the key to the cypher.

On another occasion, a surveying party went to Uxbridge early one afternoon, and made a plan of the railway station and traverses of the roads. The road traverses were taken to a signal station on Uxbridge Common, and when put together formed a plan representing an area of about a mile and a half by a mile, showing about three miles of main road with the adjacent houses, fences, and other details. The plans were messaged during the afternoon, and had the weather permitted, I believe that the whole instead of merely the plan of the station would have been heliographed to Harrow, 6 miles distant, during the afternoon; for we went to the same stations on two subsequent occasions, and eventually got the message through, chiefly with the flag, noting the time occupied. I found that the plan could be reproduced

as the message was received, so that the copy was finished within a few minutes after the signalling ceased. A tracing taken from the copy and placed over the original shows that the maximum error due to the degree of accuracy to which we were working was approached in two or three places only. I suggest that there may be occasions on which it would be advantageous to signal back a road survey and report in this manner.

Another experiment in conducting the several operations of the process as far as possible at the same time was made with the view given in Plate V of Colonel Richard's "Text Book of Military Topography." One of us sketched, and then converted into a message, a small portion of the view, and while that was being signalled sketched and messaged another small portion, and so on. This of course caused delay in the completion of the original sketch; but the reproduction easily kept pace with it, and the result appears satisfactory. The delay may be lessened by the draughtsman calling out the message as he draws to a second person to be written down, or by making the sketch upon paper ruled with more distinct lines than those on the sectional paper, so that a second person may look over his shoulder, and write out the message without interrupting the drawing. For this purpose we have used a square of tracing cloth with the lines ruled on the lower surface, and with the upper surface so prepared that pencil marks may be rubbed out when the message is completed, and the cloth may be used over again. The advantage which proceeds from conducting the several operations at the same time is that each portion of a sketch that is being made by an Officer sent out to reconnoitre, may be reproduced at the receiving station within a few moments after it is first sketched from nature, and that in the event of the reconnoitring party being cut off, or the original drawing from any cause not being safely brought back, the facsimile of as much or almost as much as has been drawn will be available for use.

One more suggestion I wish to make as to the possible utility of signalling plans in the field. It may, perhaps, prove useful in keeping communication continually open between the various moving parts of a division or divisions before and during an engagement, as well as useful in transmitting information when communication is open. My means of knowledge on this matter are of course extremely limited, my experience being limited to the Easter volunteer manœuvres, at the last two of which I have had charge of our signallers; but on those occasions I was able to appreciate the difficulty, of which I had previously heard, of keeping up communication between moving stations. At Portsmouth in 1884 a message was brought to our station to be signalled to a brigade which was in sight, but we did not know where the signal party attached to that brigade was. We failed to open direct communication with it, and some time elapsed before we found a station behind us through which the message was eventually sent round. On Easter Monday last year at Brighton, each of the signalling parties under Major Roberts (London Irish R.V.), attached to one division, by a preconcerted arrangement ascertained from the others, on taking up its position, to

which of the other stations in sight a message addressed to a particular brigade would have to be sent. On this occasion there was comparatively little movement of the signalling stations during the sham fight, and a considerable number of messages were sent through; but I think that a good deal of movement might have taken place without the different parties losing the touch that they had obtained in the few minutes before the sham fight commenced. Now I suggest that if each station were, by the system that I have described, to transmit to one central station its own position on an existing map, or if no maps were available its position with reference to conspicuous objects and features of the ground, a plan of the whole ground, showing each station, might quickly be marked or roughly made at the central station, and sent out to each station as opportunity arose. On a material alteration of the position of any station taking place, a few letters sent through would be sufficient to enable the necessary alteration to be made in the plan at each station. The movements of troops, with the times at which the movements took place, might be recorded at each station in like manner; and the plans, with their latest alterations, would, I presume, be useful to the General in command and to others under him. The Officer in command of the signallers would, moreover, have his whole command practically under his eye; he would see where fresh stations were required, and would be able to direct the movements of his signalling parties very quickly.

We have tried the system upon photographs and other likenesses, not because we at present see any practical utility in this application of it, except possibly for the apprehension of absconding criminals, but rather with a view of proving in an obvious and unmistakable manner the remarkable accuracy with which a drawing may be signalled by means of the system. For instance, the engraving of our late Colonel, J. R. Bulwer, Esq., Q.C., M.P., which appeared in "Pump Court" of October last, was put into a message; columns and rows of $\frac{1}{32}$ inch in breadth being used for the purpose. The likeness was reproduced on a larger scale, and it was not until it was approaching completion that the draughtsman perceived whom it represented. After it was finished, however, it was recognized by everyone acquainted with Colonel Bulwer who saw it.

The system which I have described is based upon the representation of the position of a point by its Cartesian co-ordinates approximately. Polar co-ordinates may be used in almost exactly the same manner, but it will be found that that system gives this peculiar result, namely, that the accuracy with which the position of a point is represented increases as its distance from the pole diminishes. The only case which has occurred to me in which this peculiarity would be advantageous is where the diagrams of a rifle match are to be signalled; for if the centre of the bullseye be taken as the pole, the better the shot the more important its exact position is, and the more accurately this position will be given; and having regard to the fact that the divisions of the target are circular, rectangular co-ordinates are inconvenient.

We attempted to post diagrams in the Union at Oxford showing the

progress of a rifle match shot last summer between our corps and the Oxford University Corps at Hincksey; but partly, I think, in consequence of my being dissuaded from using a system of polar co-ordinates, because we had not practised it, and partly because we had to work a line of three signalling stations as well as prepare the message and reproduce the diagrams with only seven available men, two of whom were themselves shooting in the match, we only succeeded in diagramming (to use a Wimbledon expression) some seventy or eighty shots with many mistakes. We hope, however, to try the experiment with greater success next summer.

I have only to add that the configuration of the surface of a solid object is transmitted when the contour lines on a map are indicated. No doubt the configuration of any solid might be signalled by extending the basis of the system to co-ordinates of three dimensions, but I am not aware that such an extension would be of practical use.

The CHAIRMAN: I am sure that all those of us who have had any experience in signalling must have heard with great astonishment the wonderful results that this system is evidently going to work out. I am happy to say that Colonel Melville, who, quite apart from Mr. Glen, was struck by the same idea of arranging some method of squares and letters in order to fix these co-ordinate points and reproduce a drawing, is here, and I will at once ask him to give us his ideas on this subject.

Colonel MELVILLE, R.E.: Lieutenant Glen having informed you that I have patented a system for signalling co-ordinates for the reproduction of plans, perhaps I may be permitted to tell you what my system is. It is very similar to his; in fact, we have been working on the same lines, though the details are carried out in a different manner. I regret that I have not had many opportunities of trying it. It has been under trial by the Quartermaster-General's Department for some months, but I have not been able to get any specimens of results. I fear I must go over, to some extent, the same ground that Lieutenant Glen has done, because both systems are based entirely on co-ordinates, but my system of sending signals is not by sending groups of letters, but simply by sending the letters giving the co-ordinates of each point. My first idea was to use section paper, but I found when one had got a point in the section paper and endeavoured to follow the lines both ways the eye was apt to get confused, and I therefore thought a sliding scale would be more easy for the purpose.

COLONEL MELVILLE'S METHOD OF REPRODUCING PLANS BY SIGNALLING CO-ORDINATES.

THE apparatus is made in two forms, viz., a table or a frame, either of which can be used.

The table has grooves cut in it, in which a rule fixed on runners slides, having room for paper and drawing pins beneath it.

The frame is similar to a square picture frame, and a rule slides over it, being guided by a metal stop at each end; the use of the frame obviates the necessity of the paper being cut to the size of the

l
e
.
y
e

d
l.
l-
I

in
his
o,
od
a

ou
he
at
ng
ent
ng
rt-
ens
nd
ely
ng
co-
out
red
d I
se.

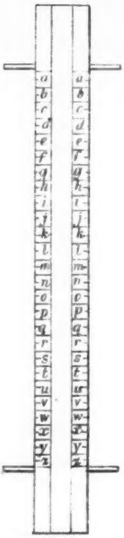
G

her

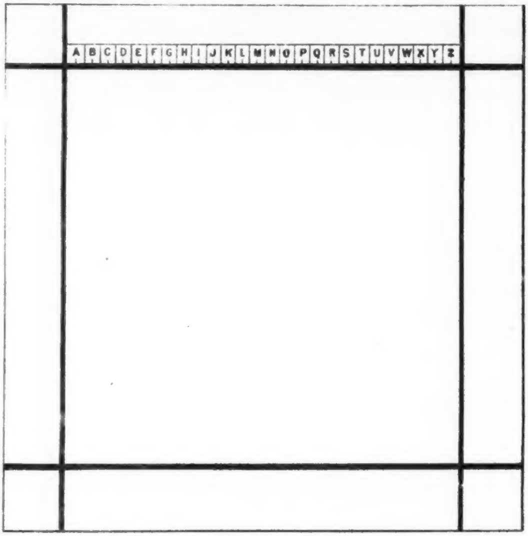
hers

ides
the
the

COLONEL MELVILLE'S METHOD OF REPRODUCING PLANS BY SIGNALLING CO-ORDINATES.

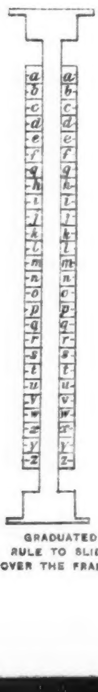


GRADUATED RULE WITH RUNNERS TO SLIDE IN GROOVES OF TABLE.



GRADUATED TABLE WITH GROOVES.

SCALE ABOUT ⅓RD OF SIZE



GRADUATED RULE TO SLIDE OVER THE FRAME.

GRADUATED FRAME.

Harrison & Sons Lith. St Martins Lane W.C.

frame; the latter can be fixed by pins at the corners. The principle of the table and frame is the same. They are graduated along one side by the alphabet in *capital* letters, each letter division being subdivided. Similarly the rule is graduated by the alphabet in *small* letters, and this alphabet on the rule slides on the frame or table at right angles to the *capital* alphabet. Any point can be determined by sliding the rule up to it, first reading the *capital* and then the *small* letter giving its co-ordinates. These letters are signalled, and the point is reproduced in position by the recipient of the signal using his rule and table in a similar way. Any feature in a plan, such as a road, river, &c., is reproduced by the transmission of its salient points in succession.

As each letter is subdivided, it can after a little practice be read to decimals when great accuracy is required, the subdivision representing 0·5. Thus, a point may be described as H_7–s_3, but a fairly accurate reproduction can be procured without decimals, the same point being read H*s*. The eye soon becomes trained to reading decimals, as it does to reading the minutes on the dial of a clock without seeing the divisions.

One need not signal beforehand with what accuracy you are going to send; that depends on the person transmitting it. The fact of the figure being sent after a letter shows that the point is determined with accuracy. Of course there are several abbreviations which may be used, but these would be ascertained by experience. I have not been working at it long enough to find out the abbreviations necessary, but supposing this [diagram] represents a contoured hill which one wanted to transmit, I propose only to signal three parts of it—the apex, the shoulder contour, and the base contour shown in thick lines in sketch, and telegraph on to interpolate the required number of contours between. Of course the distance between the contours would be settled beforehand, that 50 feet or 100 feet intervals were to be represented. It has always struck me that the telephone would be the most useful form of signalling, but there is a difficulty about the similarly sounding letters which I have tried to obviate by using monosyllables. For instance, there are the letters b, c, d, e, g, p, t, v which have very similar sounds; I try to obviate that in the telephonic signal by representing "b" by "bob," "c" by "cock," "d," "deed;" "e," "eel;" "g," "gig;" "p," "pup;" "t," "tat;" "v," "valve," monosyllables repeating the signal letter twice. "M" and "n" are also letters sounding very much alike, therefore I should use "Emma" and "any," which convey the sound more simply. As regards the scales on which the plans are drawn, they may be made of any size as may be found convenient. The way I should transmit the scale is simply this—supposing we know any portion of a plan was 700 yards long, I should simply say "from D to X 700 yards." That would be independent of the size of the sheet, and a person having plotted that length would subdivide it into 100 yards and form his scale. As regards these frames, I have submitted them to the War Office, but if they thought of making use of them they could easily be adapted to a sketching case or telephone box, or other

existing article of equipment, so as to save adding to the articles for the men to carry. I think this system would be found very useful from a captive balloon, where you wanted to get an idea of the position of an enemy or what he was doing. You might insert on a plan and transmit the trace of any works he had erected, or the disposition of his troops, or the movements of any particular columns he was working with.

Lieutenant PILKINGTON, 21st Hussars: Since the title of the very instructive and interesting paper which we have heard this afternoon appeared on the notice board of the Institution, I have heard the subject of it condemned and criticized as being rather visionary and rather impractical. It has been said that it is useless, and that its study would only be a waste of that small portion of their precious time which British Officers are willing, as a rule, to devote to the study of their profession. Now, I think everyone who has heard Mr. Glen's paper, and Colonel Melville's description of his own invention, will agree with me that those Officers have certainly not failed to arrive at practical conclusions, and that their time and energy can in no sense be said to have been thrown away. However great be the intrinsic value of Mr. Glen's paper, and much as we have all profited by his very fruitful labours, it appears to me that the greatest value, the most profitable result of his work, lies less in the elucidation of the particular subject which he has studied than in the attention which he has drawn to the possible development of that broader subject which embraces all the means by which information may be collected and transmitted in the theatre of war or on the field of battle. It cannot fail to have struck many, as it has struck me, whenever I have attempted to add to my very limited knowledge of modern war, that the mistakes so often made by even the very greatest commanders are seldom due to ignorance of theory or to error in its application, but in almost every case to some misapprehension of fact, that is to say, to the want of necessary and very often attainable information. If this be so, it is clear that any development of the means by which information may be collected and transmitted will do much to eliminate the very fatal element of chance from the game of warfare. I have no doubt that in the more accurate and extended surveys undertaken on service by Officers of the Staff or the Royal Engineers, such a system as that which Mr. Glen has elaborated will find something more than a limited application. I have, however, taken the liberty of addressing the meeting in order to point out what appears to me the special want which his suggestions, I think, in a great measure supply. I belong to that branch of the Service to which principally appertain the duties of collecting and transmitting information. Now, that in the British cavalry a very large number of non-commissioned officers, in some regiments I think I may say a majority of the non-commissioned officers, and a certain number of private soldiers also are capable of making sketches rapidly and with sufficient accuracy for military purposes, it has often occurred to me that large bodies of cavalry, regiments, brigades, or divisions might, while advancing and performing the duties of reconnaissance and screening, produce very valuable topographical reports. I may say that on a very small scale I have had an opportunity of making experiments in reconnaissances of this kind, but my experiments led to very little; the results were not satisfactory, the work done occupied, I think, more time than it would have occupied if performed by one person, and the sketches when complete were not very accurate, and in no way satisfactory. However, it appears to me that by the elaboration of some such system, or by a system elaborated from the suggestions which Mr. Glen and Colonel Melville have made, it might become possible for sufficiently accurate sketches to be made in such a manner as I have indicated. My own failure I attribute altogether to my inability to elaborate such a system as is required, and I venture to think that in such work as this, Mr. Glen's suggestions will find eventually their most appropriate application. I feel that some apology is due for occupying the time of the meeting, but if I have succeeded in making a suggestion of any value I am sure I shall be forgiven.

Lieutenant GLEN: I do not think that there is really very much to reply to in

the remarks that have been made either by Colonel Melville or by Mr. Pilkington. It does not appear to me that there is very much difference between my proposals and those of Colonel Melville as far as they respectively go. I have elaborated a system rather from the signaller's point of view. The great thing in signalling is to get every message as short as possible. In signalling in the field with flags, or heliographs, or instruments of that kind, every letter that you can save in the message is of the greatest importance, especially when, as in messages of this kind, every letter has to be signalled at least twice, has to be collated in order that it may be got through correctly. I have, therefore, endeavoured to make rules which should produce as short a message as possible. For instance, in the case of that plan that we made at Uxbridge, the message actually sent through consisted, I think, of some 1,200 letters. That was in a somewhat early stage of our rules. We went on elaborating our rules, and in a very short time we had reduced that message to about 800 letters, and it still contained exactly the same information as the original 1,200. We have gone on in that way trying to reduce our message without depriving it of any accuracy. So far as the rough sketch goes, using columns and rows of about ¼ of an inch, there is practically no difference between my proposal and that of Colonel Melville. If you can get a telephone to use, certainly you do not want so elaborate a set of rules as those which we have devised; you can send any amount of information about the different points that you refer to without much waste of time. If the message has to be sent by electric telegraph or by heliograph, or much more if it has to be sent by flag, you do, I think, need a written message, because we find that mistakes cannot always be avoided. In signalling an ordinary intelligible message it is not very difficult to fill up a letter here and there in a word; the majority of letters in a word indicate what the word is, and you can fill up the letters that have gone wrong, because, even with the best signallers that I have seen, letters do go wrong sometimes, but if they go wrong in signalling a map of this kind, you must be able to put your finger on them, and have them verified from the other end of the line, and it is with that object that we have devised this system of prefixes and the other rules. So long as you use this simple 6-inch square and ¼-inch columns and rows you require no prefix at all—you only use the rules of which I have spoken in explaining that first diagram, for making a line begin and stop, and saving a letter or two. But when you wish to be very accurate over any particular part of the map, for instance, if a reconnoitring Officer making a general sketch of the country wishes to give a more accurate description of a particular position that he sees, then he may draw that position much more carefully than the rest of his map, and in converting it into a message he will put that little hollow square over it and at once describe it on a very much more accurate scale without increasing the number of letters in the description. The only increase in the number of letters in the message will be the three letters which indicate the prefix of that little square. He would give the prefix, for instance, E, D, S, which represents the position of that 1½-inch square, in Fig. 4, and then he would go on using no more letters in his message for the very accurate scale than if he had been drawing on the rougher scale. I am greatly obliged to Mr. Pilkington for his remarks with regard to my suggestions in connection with information on the field of battle. It appears to me that something might be done in that direction. Unless some scheme is organized beforehand, either in this way or in some other, signalling parties get out of sight of each other: they are wandering hopelessly about the field looking for something to do, quite incapable of sending a message anywhere if they get one to send. I have heard signal Officers of the regular Army speak of the great difficulty that there is in keeping moving stations in sight of each other, and so far as I have knowledge of the subject, it appears to me that that difficulty is really very serious. If they can be kept together, the strings, so to speak, of the whole series of signalling stations being held by one man, it will be, I imagine, a very important point gained. I have nothing further to say except to thank Colonel Moncrieff very much for having taken the chair at this meeting this afternoon, and the audience for so kindly listening to me.

The CHAIRMAN: I must say I think that great credit is due to Lieutenant Glen for this most interesting lecture. A good deal of the details may, perhaps, have

been rather dry for the listener, but I think with the excellent plans that he has drawn out he has succeeded in making his rules for the abbreviation of messages thoroughly intelligible to us all. It appears to me that his system of signalling information in the form of a sketch, giving details of the position of troops, &c., is most valuable, and it will be a very great advantage at headquarters if they can get such information from distant outposts or cavalry screens without the delay of sending them by messenger on horseback. I can assure you that Mr. Glen has worked with extraordinary assiduity at this subject, and notwithstanding the large amount of time that he has to give to his own profession, he has been able to devote many spare hours to working out this system. I give him particular credit for having reduced the length of the messages in a most extraordinary way, and am quite certain that no one but an Officer thoroughly practised in signalling could possibly have elaborated the scheme which he has placed before us in the manner in which he has done. I am sure you will all unite with me in returning him our best thanks.

Wednesday, January 27, 1886.

MAJOR-GENERAL SIR ANDREW CLARKE, G.C.M.G., C.B., R.E., Inspector-General of Fortifications, &c., in the Chair.

ON LAND MINES.

By Major SALE, C.M.G., R.E.

THE subject of the paper as announced for the meeting of this afternoon is Land Mines, but the writer does not propose to touch upon that branch of military mining which involves the use of shafts and galleries and such like subterranean warfare.

He proposes rather to deal with that class of small surface defence mines which might be more properly termed land torpedoes.

At first sight it would seem an easy and obvious adjunct to the defence to place a number of small concealed mines in the attacker's path of advance, and in fact the use of land torpedoes has been from time to time suggested and attempted, but seldom with any satisfactory result; either the firing arrangements have been unsuccessful or the torpedoes have been exploded at the wrong moment, or—as too often the case—the person setting the mine has been blown up by his own torpedo; in short, hitherto land torpedoes have been but of little actual use.

Nor is the cause far to seek. In the first place, the range of destructive effect is very limited. If the torpedo is not concealed it can be avoided with ease, but if concealed it must ordinarily be either below the surface of the ground or masked in some manner.

This in itself is sufficient to restrict the horizontal effect, and throw up into the air nearly the whole force of the explosion.

It is remarkable how small is the horizontal effect produced by even large charges which are buried however slightly below the surface of the ground.

Then again the firing arrangements have been a frequent source of failure, mechanical mines having involved too much risk in setting and recovering, and electrically fired mines have failed at critical moments owing to the fuzes, firing batteries, or wires going wrong, or as very notably the case in the late operations at Suakin, mines have failed because detected by the enemy.

It should, however, be borne in mind that the land torpedoes hitherto used have for the most part been rough improvised arrangements, made for special occasions, unfamiliar to the men using them, and often faulty in mechanical details.

It would be rash to assume that, if properly devised land torpedoes

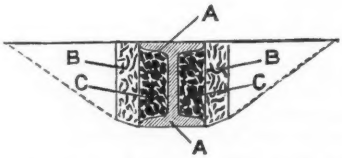
are to be had, simple and certain in action, and sufficiently portable and safe to be handled without undue risk, a notable effect might not be produced by them in warfare.

Let us examine in some detail the conditions to be fulfilled in an efficient land torpedo.

First.—As to the form of the mine, without reference to firing arrangements.

To be effective it must be readily concealed, and yet as close to the surface of the ground as possible, otherwise the horizontal effect will be almost *nil*, and it should be so made as to offer a maximum resistance to the upward force of the explosion in order to develop the horizontal effect to the utmost.

Where portability is not a great object this end can to a certain extent be attained (using gunpowder as the explosive) by the use of the form of case shown in the diagram, where AA is a strong steel dumb-bell, so placed as to form a sort of core for the charge, the upper disc of the dumb-bell being flush with the top of the mine and with the surface of the ground.



AA, Iron dumb-bell; BB, Layer of broken iron surrounding the charge.

It has been found that by experiments made at Chatham, and by trials made by the Confederates during the American War, that a core of this sort has an effect in increasing the horizontal power of the explosion, but it necessarily adds very much to the weight of the torpedo and complicates its construction, and moreover would be of but little or no use where charges of any of the high explosives are used.

Then again the torpedo should be surrounded with a sufficient quantity of fragments of metal, grape-shot, or bullets, to act as missiles, after the manner of an improved fougasse. For this purpose metal punchings are very suitable, such as are to be had in abundance in any factory for structures in wrought iron or steel.

Lastly, the torpedo should be fairly portable and sufficiently waterproof to resist damp and rain-water.

These requirements necessarily involve a very considerable weight, the steel core alone for an 8-lb. charge would be 17 lbs., and the surrounding charge of metal fragments not less than 160 lbs., so that a torpedo to meet the conditions above described could hardly be made to weigh less than 185 lbs., which would, considering the limited range of effect, be almost prohibitory for field service where transport would of necessity be limited.

The use of such heavy torpedoes must therefore be restricted to places where facilities exist for bringing up heavy stores.

But if we abandon the use of gunpowder and employ high explosives we may reduce weight to a minimum, the dumb-bell form may be abandoned, as the action of such explosives is so violent and sudden that any effective resistance to the upward force of the explosion could hardly be offered by any practicable form of case, and we can dispense with the surrounding of metal fragments as missiles, trusting to local supply, stones, &c., for charging the mine, or even to the simple shock of the detonation of these violent explosives.

In many of the proposed torpedoes this shock action is alone trusted to, and very exaggerated ideas have been held as to the range of such effect. One inventor has stated that the shock of a 6-lb. charge of blasting gelatine would necessarily be fatal to anything within a radius of 25 yards, the statement being professedly based on actual trial; another inventor has with the utmost confidence asserted that detonation of a charge of 300 lbs. of dynamite would be fatal to human life within a radius of a quarter of a mile, and in fact the most absurdly exaggerated ideas as to the forces of these high explosives are prevalent.[1]

Attempts have been made to determine the radius within which the mere shock-action of the detonation of moderate charges of high explosives would prove effective.

To make a direct experiment is out of the question, we cannot make trials of this sort on living creatures, and all results obtained on inanimate objects are inconclusive,[2] but from observed effects the writer is of opinion that a 6-lb. charge of dynamite or guncotton would not—by mere shock-action—be fatal, or even inflict serious injury outside a radius of 6 yards.

Assuming, then, that high explosives are made use of for the more portable form of torpedo, we can reduce the necessary weight of the mine to but little more than the actual weight of the explosives; with mechanical mines a charge of 6 lbs. of dynamite or gelatine, with firing apparatus, all contained in a strong case, can be made under 10 lbs. in weight, and in a very compact and portable form.

With electro-firing mines the weight of the mine can be still further reduced, but here the weight of the electric wires is a serious item.

In view of the above considerations the writer is of opinion that two distinct forms of torpedo should be used, viz. :—

One for siege requirements where weight is not a primary consideration, and one for field requirements where extreme portability is

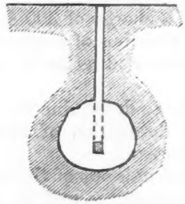
[1] The very limited range of the shock-effect of high explosives is strikingly shown by the fact that at the great dynamite explosion at Kimberley, Cape of Good Hope, in January, 1884, the explosion of 46 tons of powder and dynamite (including over 30 tons of dynamite) did no harm to men only 500 yards off in a straight line fully exposed to the direct force of the explosion.

[2] In the course of some experiments, in which it was attempted to gauge the force of the shock-action by the breakage of strong paper screens placed at various distances from the explosion of small charges, the writer was standing by a screen when it was shattered by the shock—the writer, however, feeling no inconvenience.

essential; the former to be made for the use of gunpowder with a special heavy case and surrounding layer of missiles, and the latter to be simply a charge of some high explosive enclosed in a strong waterproof case.

Where high explosives are at hand, there is a method by which a considerable charge—say 100 lbs. and upwards—of powerful explosives can be deposited under ground very quickly without the use of galleries, and with but little disturbance of the surface.

A hole is bored or jumped with an iron rod for, say, 6 feet deep, a 3-oz. charge of guncotton is then pushed to the bottom of the hole, and detonated, the explosion of this small charge by the powerful compression exerted on the surrounding earth forms a spherical cavity, whose lowest part is somewhat below the bottom of the original bore-hole.



Into this cavity cartridges of blasting gelatine can be passed, which can be detonated by a dynamite primer enclosed in a waterproof bag. As blasting gelatine is not materially affected by damp or wet, such a mine could be kept effective for a very long time, and would be extremely difficult to detect, owing to the very slight disturbance of the surface due to lodging the mine.

In very dry soils, such as occur in rainless districts, gunpowder might be passed into the cavity. Though such a mine could be well concealed, and could be made to contain a very powerful charge, a great proportion of the force of the explosion would be wasted in an upward direction, owing to the circumstance that the charge is placed at some distance below the surface of the ground; moreover, this method can only be used successfully where the soil is favourable.

Arrangements for Firing.

As regards the arrangements for firing the torpedo, the first and most obvious plan is to devise some arrangement whereby the charges shall be mechanically and automatically fired on the approach of the enemy either by treading on the mine itself or by tripping on wires, which thereby release a striker in the mine itself.

This in itself is a matter of great simplicity. In the American War a mine of this sort was used, in which the whole apparatus for firing consisted of a sort of metal knob, covered with a thin layer of fulmi-

nating composition, which was so compressed as to explode when subjected to a certain pressure.

This knob was covered with a cap of thin flexible metal, and was itself screwed on to the upper part of the torpedo.

Actual tread on this knob or the pressure transmitted by the bending of a small deck or platform placed over it sufficed to fire the fulminating composition.

Nothing could well be simpler, but unfortunately, also, nothing could well be more dangerous, in fact such a mine would be almost as dangerous to friend as to foe, both in setting and recovery.

It is, however, comparatively easy to devise a mechanically-fired mine which shall be certain and simple in action.

If this were all that is necessary the problem would be simple, but it is unfortunately also necessary to provide for the safe recovery of the mine when occasion requires. It is here that the difficulty arises, and although many ingenious devices have been proposed, none that the writer knows of provide sufficiently for the safe recovery of the mine, whilst at the same time allowing of the effectual concealment of means whereby the mine is to be rendered safe or inert for recovery.

The firing arrangements of most of the proposed mechanical mines consist of a detonating cap fired by a striker which is actuated by a spring held back by a trigger or some analogous arrangement, and locked by a safety-pin.

The mine is set whilst the safety-pin is in position, and when all is ready the operator retires to a safe distance, and pulls out the safety-pin by means of a line or lanyard attached thereto.

Safe recovery is usually provided for by a second line or wire, which actuates a safety-catch in such a manner that the operator can by pulling on the wire so set the catch as to prevent the disengagement of the striker. This in itself is an insufficient precaution, as the safety-line, being necessarily concealed, cannot be depended upon in its action; this makes it necessary to provide some mode by which it can be seen on approach if the mine is safe or not.

It will readily be understood that the necessity for an indicator makes the proper concealment of the mine a matter of the utmost difficulty. Probably the best mode of meeting this difficulty which has yet been devised is the method proposed by Major Bucknill, R.E.

In this device the mine is covered by a small and light triangular shaped board, the hauling on the safety-line not only sets the mechanism to safety but discloses the mine by drawing off the light covering board. Even this method, however, is not free from objection.

Perhaps the best possible arrangement would be that the torpedo

should be provided with two safety lines, one for setting by withdrawing a safety-pin to render the mine active, and a second for rendering the mine safe by withdrawing either the actuating spring itself or some part of the mechanism essential to its action, so as to make it absolutely certain to the operator when he has hauled in the safety line with this portion of the mechanism attached that the mine could be no longer in an active state, *e.g.*, a friction tube connected by a link with the firing gear; the removal of this link would absolutely sever all connection with the firing gear, and so ensure safety. Even, however, if an arrangement of this sort could be devised to work perfectly there would remain much risk in approaching mechanical mines after once set; the safety-line might be cut, or being concealed its locality might not be discovered, or the indicator might be concealed by earth, &c., rendering uncertain if the mine had been set to safety. So that it might be necessary to approach close and search for an active mechanical mine; a proceeding by which accident is almost ensured.

In the recent operations at Suakin, mechanical mines were used; and as the Arabs showed the most extraordinary keenness in detecting any kind of tripping-wire or safety-line, the torpedoes were set to explode when trodden on, and without safety lines for recovery. Owing to this a deplorable accident ensued, by which the life of a young and most promising Officer was lost.

Briefly, it may be said that mechanical mines are unsatisfactory, imperfect, and decidedly dangerous, and should not be used except under very special circumstances.

Electric Firing.

Most of the difficulties in the way of using mechanical mines do not hold good when we make use of electricity for firing.

The motive power which fires the mine does not or need not be in the mine itself, while groups of mines can be connected to one firing battery, which may be far from the mines; the moment this battery is disconnected these groups become necessarily inert.

There are no complications such as safety-lines, indicators, &c., the mines can be effectually concealed, and the contact mechanism, by automatic firing, may be of the very simplest possible kind.

Two serious drawbacks have hitherto attended the use of electricity for firing mines in the field: the necessity for using a voltaic battery and the need for considerable lengths of insulated wires.

For electro-contact firing we must have a battery which remains always ready to do its work directly contact is made, and is, moreover, sufficiently powerful for firing purposes, and sufficiently simple and portable for use in the field. None of the portable magneto-electric exploders will answer the purpose.

Hitherto such a battery has not been available; either there has been a necessity for the use of corrosive acids or the battery has been bulky, required careful manipulation, and could not be trusted to remain constant.

Recently, however, a battery has been introduced into the Service,

which seems to answer fairly all requirements: it is so simple that all that is required to charge it is to fill up each cell with water. It will remain ready for work for months without any attention, is quite powerful enough for a firing battery, is fairly portable, and is not unduly expensive; moreover, it is the battery which is now approved for use in military telegraph equipment, so that it is well known in the Service.

Such a battery has been practically tested by connecting it up with a series of dummy electro-contact mines laid out in the open ground.

Though these electro-contact mines (containing electric fuzes only) were of the roughest possible kind, and were almost entirely unprotected from wet and earth contact, though the mines were sodden with moisture and for some days covered with snow, the whole system, battery included, remained efficient for three months without any attention whatever, and during this time the dummy mines were from time to time fired by contact, and were uniformly found to act.

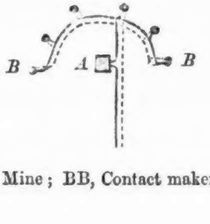
This test appeared to the writer to be conclusive as to the efficiency of the battery under Service conditions.

As regards the use of insulated wires no doubt this is a serious drawback to the use of electricity, but great improvements have been made in the manufacture of these wires, and samples are now to be had weighing only 97 lbs. per mile, and yet sufficiently well insulated, of good tensile strength (breaking strain 150 lbs.), and not having too high a resistance (26 ohms).

Electric fuzes were formerly a frequent source of failure, but now the electric low tension fuzes and detonators used in the Service are quite simple and reliable.

Upon the whole it appears to the writer that the advantages to be gained by the use of electricity so decidedly preponderate over the drawbacks, that this mode of firing land mines should in almost every case be preferred to mechanical methods.

In electro-contact mines it is by no means necessary that the contact apparatus should be in the mine itself; any number of these contact makers (which may be simple modifications of the ordinary bell-push) may be placed about, in front, or around the mine, and so arranged that by making contact by tread or tripping-wire, or even by any attempt to cut the wires, the one particular mine to which they are connected shall be fired without throwing out of action the other mines of the group served by the same battery.



A, Mine; BB, Contact makers.

The diagram shows the method of connecting up a group of contact makers with the mine; one battery of twenty cells would serve almost any number of mines within a radius of 500 yards.

Any testing required is of the simplest possible kind, and is fully provided for in the electric testing gear which forms a part of the R.E. equipment in the field.

Having discussed the form and mode of firing land torpedoes, it remains to consider on what occasions such articles could be advantageously used in warfare, or if they could under any circumstances be advantageously used.

It may be conceded at once that under any circumstances the actual casualties caused by land mines would be but small, for one mine exploded with effect many would probably be harmless. Nor does it appear probable that torpedoes would ever be used for the defence of fortified positions in supersession of other modes of defence.

But as an adjunct to the defence to be used in places near the defended post where accidents of ground prevent an effective searching musketry fire, a few torpedoes might be employed with great effect. They would help to prevent the enemy from taking cover and collecting in such ground for a final rush. Or they could be used in conjunction with wire entanglement to check a rush where musketry fire would be weak.

If placed a few feet in front of the wire entanglement, and with their contact arrangements in connection with it, they would effectually check any attempt to demolish the entanglements, which, however, their explosion would not materially displace; they could also be effectively used in conjunction with wire entanglement for defending the wide shallow ditches of earthworks.

For the defence of isolated posts in savage warfare where sudden night attacks are to be expected, electro-contact land torpedoes might be very usefully employed, both for their deterrent effect and also because they would serve as detectors or alarms.

It should not be forgotten that casualties caused by mines have more effect on *morale* than a far greater number of casualties caused by musketry fire, the sight of men being blown up by mines, combined with the knowledge or even supposition that the ground to be advanced over was mined, has been found to try the nerves of the bravest.

For mountain warfare there is also scope for the use of torpedoes. The roads through a mountain pass, defended at suitable points by a number of torpedoes skilfully concealed, could only be traversed by the enemy after a careful search for and hazardous removal of all the mines.

The utmost confusion and delay might be caused by the successful explosion of even one torpedo in such a road crowded with men and baggage animals.

By the use of concealed electro-contact land torpedoes, bridges and railways can be prepared at leisure for demolition, the friendly traffic can be allowed to pass up to the last moment, nothing more being

required for the setting of the torpedoes at the last moment but the connecting up of the wires from the concealed battery.

To be effective torpedoes should not be set where the enemy has the means of making a leisurely and undisturbed examination of the ground defended by them.

Upon the whole it appears to the writer that there are so many occasions on which land torpedoes could be used with much effect, and the difficulties in the way of using these appliances have been of late so much lessened, that in spite of the natural dislike to make use of such, as it were, underhand weapons, the time has come for adopting them into the Service, not as mere makeshifts, but as articles of store carefully worked out in all details.

It is essential to the proper handling of such weapons that the persons who have to make use of them shall be thoroughly familiar with all their details, mode of setting, &c. However simple and efficient a pattern of torpedo be provided there must inevitably be a number of small details which have to be attended to if success is to be obtained and accident avoided.

No instructions, however carefully prepared, can supply the place of experience gained by actual use. When knowledge of the use of such gear is acquired by reading only some detail is sure to be forgotten at the critical moment, and any error when dealing with concealed torpedoes—especially mechanical ones—means failure or even fatal accident to the user.

Note.—Since the reading of this paper the writer has been favoured with the subjoined account of some electro-contact land mines used with much effect at Suakin.

Land Mines in the Soudan.

Mine laid out by H.M.S. "Carysfort" at Suakin.

Several guncotton mines, arranged to be fired at will by electricity from a fort, were laid out with but indifferent results. As a number of natives were allowed to go in and out during the day, from these the enemy no doubt got information, for on several occasions the wires were cut, the mine thus rendered harmless, and then carried off bodily.

About this time the night attacks were very harassing, and it was most desirable to check them, so a mine was arranged as follows:—A guncotton charge to be fired by electricity was placed in a cask with two circuits fitted to it, one starting from an electric battery in the fort, then to a firing key there, then away to the electric fuze in the mine, and so back to the battery; the other being from a battery in the cask to a circuit closer, which would only complete the current when the cask was on its side, through a length of wire going outside the cask by the bunghole with the end insulated, this to be joined to another insulated end, and this wire back through the bunghole to the battery. It will be seen, then, that the mine could be fired in two perfectly different ways—either at will from the fort, or by the circuit closer in the mine making contact, which would

happen if it were laid on its side, the wires being then joined up. A hole was then dug and the cask placed in it; the two wires coming out of the bunghole were then joined at a safe distance from the mine, and as the mine did not fire it was evident that the circuit closer was not making contact, and so the bight could be stuffed into the bung-hole with safety. At night the enemy came, cut the wires leading to the fort, and hoisted the cask out of the hole. They then laid it on its side, and the charge exploded with disastrous consequences to them. After this the night attacks ceased for two months. An explosion at a distance was heard some time afterwards, and it appeared that the Arabs, finding one mine had gone off after the wires were cut, considered the ones they had carried off untrustworthy, and set fire to the whole of them; as the detonators were presumably still in the charges, an explosion occurred which did great damage.

Note.—The above account is given from what has been heard of the mines at Suakin, and is from memory.

Commander A. KINGSCOTE, R.N.: I should like to say a few words about my own experience in the Navy during the Zulu war, and also at Suakin, when commanding the "Woodlark." In the Zulu war I was left in command of both banks of the Tugela, with the men of the "Tenedos," the ship that I was First Lieutenant of, by Lord Chelmsford, and I asked for and had brought up 100-lb. torpedoes from the ships at Durban, and laid them out as fougasses at each angle of our redoubt called Fort Tenedos. I found them most effective for frightening the natives and for actual work. I can also answer for the small stake mines laid out at Ekowe, as explained by Major Sale. I was not there, but brother Officers told me of them, and that they answered the purpose very well in frightening the natives, but that was all. I must say my own experience about land mines is that they must be electrical, and not mechanical, to be of any real good in actual civilized warfare. If friction tubes are used, as instanced by the lecturer, damp or wet weather affect them at once: this we find on board a man-of-war, where the greatest care is taken of them. Mines for effect must be electrically fired by hand from the redoubt or place of observation. I should also like to say a few words on what I saw at Suakin with regard to laying out electro-mechanical mines to frighten the natives away. The best one I saw there was one fitted with naval stores, the mechanical part consisting of an upright tube half full of mercury, which on being well shook, slanted, or turned over, made contact, and by aid of a battery inside, blew up. Early one morning in August, one and a half years ago, twenty-seven natives were killed by one of these, and they are by far the best of this class with the battery and mechanical arrangement in the mine. When the wretched men took up the mine and turned it over, after cutting the dummy wires, it went off at once. On another occasion, another mine of the same kind was carried all the way from near Suakin to Handoub, as much as 6 or 7 miles, and then when they put it down, it turned over and blew up, some fifteen men being killed. I think electro-mechanical mines are useful for ordinary native savage warfare, especially to frighten them; but I do not believe in them for actual fighting against civilized nations—the only ones of use then would be electrical mines fired by hand.

Captain M'EVOY: I should like to make a few remarks with regard to the land mines employed during the American war, on the line of the James River and on the peninsula about Yorktown, and also with regard to those employed about the fortifications below Richmond. They were of a much cruder form than even Major Sale has pointed out. I saw many thousands of them, and those that I saw were simply 9-inch spherical shells, with what was known as Rain's sensitive fuze, which went off with a pressure of 8 ounces. These shells were fitted with fuzes of that sort, placed in the ordinary fuze hole in which fuzes are used when shells are

employed for artillery. They were covered with a simple conical tin case, which slid down and fitted tightly over the spherical form. The top of the tin case stood a little off the fuze, so that the pressure of a man's foot forced it down and exploded the shell. There were a great many lives lost by the attacking parties on the peninsula, by these mines. They were put in rows, and the earth was thrown over them to the depth of from 3 to 6 inches. The earth was so arranged as to make a slight cover for a red piece of paper or cloth, which could be seen from the fortifications, while the enemy attacking could not see it, the earth being banked up on the side towards the enemy. There was considerable loss of life from these mines in the attacks on Forts Harrison and Gilmore, below Richmond. Fort Harrison was captured, but Fort Gilmore was not, the attacking parties being repulsed mainly by the land mines. A great many land mines were employed about Savannah and Mobile, and were reported to have been very effectual against attacking parties. Reports were made to the department in Richmond to which I was attached, of attempts to employ electrically arranged mines. The most notable instance, I think, was in connection with the mines at Fort Fisher at the mouth of the Cape Fear River. The fort, it will be remembered, was subjected to a severe bombardment, forty vessels with 300 guns played on it nearly all day, while a heavy land force waited to make the assault, which was finally delivered at night. The severe bombardment destroyed all the electrical mines which were laid from 3 to 5 feet under the earth. They were mainly intended for the assault which was expected as soon as the bombardment had ceased, but the heavy shells from the guns of the fleet ploughed up the ground and destroyed the wires and mines, so that when the assault was delivered late at night, the fort was carried, after severe fighting, the mines being perfectly useless. I have not heard of the employment of electrical mines about Petersburg, which may, however, have been the case. The mechanical mines were sometimes called emergency mines. They were only put down in cases of emergency, and taken up as soon as they could be dispensed with. I should think their moral effect was greater than their actual effect, but their actual effect was not altogether *nil*. Many attempts have been made to improve land mines. I have done a little inventing in that line myself. I should think that a friction tube could not be very effectual. All who have had any practice in pulling a lanyard and firing a tube in a gun must know how hard a pull it takes. I should think a man must bring a considerable strain on the wire to fire a friction tube in a land mine. It seems to me that the most certain land mines, mechanical or electro-contact, would be those that acted from a direct pressure brought upon them, and where everything connected with the firing arrangement would be inside of the mine itself. Guide wires coming to a point, and reaching mine after mine, might be found to be a safe means of pulling down and taking up the mines.

Colonel SCHAW, R.E.: I should just like to remind Major Sale (no doubt he forgot it in preparing his lecture), that there was a remarkable application of torpedoes or land mines lately, which we have all read about, namely, at the defence of Khartoum. General Gordon used them very largely and successfully, and they were extemporized mines. As far as we know he had only lucifer matches as his means of ignition, and yet he produced remarkable effects. The dryness of the climate no doubt helped him, and his own great mechanical genius helped him too. I wish to draw attention to it as an instance of mines being used very successfully with imperfect means.[1]

---

[1] In reply to Major Sale's observation, it is to be noted that the accident he refers to, by which a native, whom General Gordon had made his commanding engineer, lost his life, can hardly be accepted as a reason for ignoring these extemporized land mines. Could any other mode of defence have been employed which would have produced such results with so little loss to the defenders? And have we not to deplore the loss of a promising Royal Engineer Officer at Suakin when dealing with land mines, prepared by English mechanics, with all the resources of civilization to aid them? Let us award ungrudging honour to General Gordon for the wonderful defence of Khartoum, in which land mines played so prominent a part; but at the same time we must not slacken our efforts to work out a pattern of land mines which shall combine the maximum of danger to enemies with the minimum of risk to those who employ them.—H. S.

Colonel MONCRIEFF, C.B.: I would only make one remark. In the Crimea, the Russians made mines of that description, and I happened to associate with some of the Officers, who considered that nothing daunted the men so much as those mines. They had difficulty in getting them to go about, and the casualties were very few.

The CHAIRMAN: I am afraid that the subject of our lecture this evening has hardly reached that stage in which there is very much difference of opinion with reference to the application of one system or another; and it is due to that rather than to any lack of interest taken in the subject that we have had so few observations offered upon the interesting lecture by Major Sale. I shall now ask him, if he desires to make any further observation, to do so now, and not longer detain you.

Major SALE, in reply, said: I have very little more to say, gentlemen; but referring to the case of Khartoum, it had not escaped my recollection. But in the first place, the information with regard to the mines was exceedingly scanty. One heard the bare fact that lucifer matches had been used for firing the mines, which we know could only have been under extraordinary and exceptional conditions of climate, &c. We heard that they had produced an effect, but no precise information concerning them had reached us. We did, however, hear that the engineer employed on them had been blown up. I hardly took that as an encouragement for the use of these mines. With regard to the use of the friction tube for the firing of mines, the direct pull no doubt is considerable (60 to 70 lbs.). What I suggested was that a powerful spiral spring should be held back by a trigger, and that disconnection should take place by pulling out the connecting link. That I take to be as near perfect safety as you could have with any mechanical mine; but at the best, as I have endeavoured to bring to notice, mechanical mines are clumsy and dangerous.

The CHAIRMAN: It is now my duty to ask you to give your thanks to Major Sale for the lecture he has given us. There is one little point to which I may call attention with reference to the construction of a paragraph in the paper. As it is written one might be led to believe, as I was in the first instance, that the accident at Suakin was from an electrical mine. It was not: it was from a mechanical mine as we know. The subject is now being carefully considered by the Officers who are responsible for this measure of defence, and, speaking to you and to the country generally, I may say I think it will be found in a very short time that in this character of defence we shall not be behind other nations. I have every hope, in fact every confidence, that we shall be able to organize a defence of this kind which will be fairly safe and also effective. It will now only be necessary for me to ask you, gentlemen, to allow me to return our thanks to Major Sale for his interesting lecture.

Friday, January 29, 1886.

General Sir C. P. BEAUCHAMP WALKER, K.C.B., Vice-President, in the Chair.

THE USE OF PIGEONS AS MESSENGERS IN WAR AND THE MILITARY PIGEON SYSTEMS OF EUROPE.

By Captain H. T. W. Allatt, Duke of Cornwall's Light Infantry, &c.

The maintenance of communications in war is of paramount importance. A reliable and rapid system of communication may be said to be an essential element of success. The methods employed will vary with the many different conditions under which the military operations are conducted. Mounted messengers, railways, and telegraphs may be classed as the ordinary means by which intelligence is conveyed, the value of each depending upon the rapidity of transit.

Of these the electric telegraph is obviously the most valuable and the most satisfactory, but it is at the same time the most delicate and the most liable to interruption or destruction. It is therefore imperative to consider in what manner messages can be safely and expeditiously transmitted to their destination when telegraphs fail, and railways and human messengers are too slow to be of any value or cannot be used. We in England are apparently somewhat behindhand in the solution of this problem, although many of our recent wars have afforded favourable opportunities of studying it.

On several occasions we have put up with the interruption of our communications for more or less lengthened periods. We all remember the isolation of General Roberts and his troops in Cabul. In the Zulu and Boer Wars several of our posts were cut off. In General Graham's campaign of 1883 our telegraphic communication between Suakin and Berber was constantly interrupted, sometimes for several consecutive days. In the expedition of the unfortunate Hicks Pacha, no attempt was made to maintain communications. In 1885, when Sir Herbert Stewart led his little force across the desert to save Khartoum, no communication was received from him for a full week after the news of the fight at Abu-Klea. And, lastly, in the recent Burmah War no news was received from the front between the 21st and 27th November, 1885.

The application of other and extraordinary methods of corresponding becomes necessary under any of the following circumstances:[1]—

[1] See "Kriegs-Telegraphie," by R. von Fischer-Truenfeld, Berlin, 1879.

1. When the necessary supply of materials for the construction of the telegraph is not forthcoming.
2. In communicating to and from an invested place.
3. In countries where the establishment of the telegraph is the work of much time and labour, as in mountainous or swampy districts, &c., or where the telegraph cannot be efficiently guarded.
4. In combined operations between a moving fleet and coast fortresses or land forces.

All these cases, except the second, can usually be met by the application of signalling. The excellent work done by our signallers in Afghanistan, in South Africa, and in the Soudan is known to most of us. There are, nevertheless, conditions under which the establishment of signal stations becomes a work of difficulty owing to the presence and activity of the enemy, to the topographical peculiarities of the country, or to atmospheric causes. In such cases long-distance signalling cannot always be established, and if established, it might not be a desirable method to employ. The prominent points chosen as transmitting stations would be precisely the ones that would be first seized by an enemy, and even if such points were occupied and guarded, a civilized enemy might be able to read every message that was signalled.

Another case is the absence of suitable points on which to establish stations. This difficulty was encountered by the signallers with Sir Charles Warren's force in Bechuanaland, and is thus recorded:[1] "The country between Maritzani and Mafeking consists of long rolling plateaux, covered with thick bush and thorn trees, rendering signalling without artificial aid impossible. A series of mounds had therefore to be constructed as rapidly as possible, and lanes cut through the bush and thorn trees, which of necessity occupied so much time, that through communication was not established until a week after General Warren's arrival at Mafeking." Lastly, any means of communication which depends upon the deciphering of signals exhibited at a distant station is necessarily dependent upon contingencies of weather. Thus we find that the interesting series of military signalling operations which were carried out between Richmond and Portsmouth in August, 1884, were very much interfered with by the atmospheric surroundings, "which on two successive days prevented the use of the heliograph except at rare intervals, and then only for a minute or two at a time." In 1885 better results were obtained, but it was found that "the drift of the smoke from London made it impossible for the signal party at the station on the Epsom Downs to discern more than the barest outline of the next point of observation some 14 miles distant."[2]

Having regard to these and similar cases in which we cannot look to the signalling staff readily to establish communication, it becomes

[1] See "The Military Telegraph Bulletin," p. 153, 15th October, 1885.

[2] Pigeon races with young birds took place in the South of England on each of these days in 1884 and 1885.

necessary to investigate the merits of other methods which suggest themselves for consideration.

The application of balloons is confined to very narrow limits. Despite the great improvements both in speed and steering power lately effected by French aëronauts, they are not yet in a condition to undertake so important and delicate a task.[1] During the siege of Paris sixty-four balloons left the capital. Two, of which no tidings were ever received, were probably lost at sea; five were taken by the Germans, viz., three of them in the occupied parts of France, one in Bavaria, and one in Prussia; six were carried into Belgium, five into Holland, and one landed in Norway. The remaining forty-five descended, more or less successfully, in French territory not in occupation of the enemy.[2] An attempt was made by Monsieur Tissandier, the well-known aëronaut, to reach Paris in a balloon, but without success. What the future may bring forth in the way of improvements in aëronautics cannot even be estimated at the present time, but until some radical change takes place it is evident that balloons are too much at the mercy of the winds to be depended on either for accuracy or speed.

The only remaining medium for carrying information is the intelligent, hardy, incorruptible, and home-loving messenger pigeon. To the services of these birds the Parisians were indebted for the only news that reached them from outer France, during the four and a half dreary months that the investment lasted.

Before proceeding further, it is necessary to make some allusion to the name by which pigeons which fly long distances are known in this country. It is a common error amongst those whose love and knowledge of pigeons are derived from the process which usually follows the appearance of a bunch of their innocent little toes protruding from the centre of a pie-crust, to apply the term "Carrier Pigeon" to these birds. This from a pigeon fancier's point of view is an unqualified mistake. The English carrier is a purely fancy variety, bred up to an artificial standard of perfection, but quite useless as a messenger pigeon: during the past 200 years this breed has never been employed in this country for that purpose.[3]

Although undoubtedly the descendants of the Persian carrier[4]

[1] There is an excellent article on "Carrier Pigeons in Warfare" in "Colburn's United Service Magazine" for March, 1885.

[2] "En Ballon! pendant le Siège de Paris," by Gaston Tissandier.

[3] In Moore's "Columbarium" (1735), it is stated that good carriers are too valuable to be employed in this manner, and that pigeons called "Dragons" and "Horsemen" are the breeds used as messengers in England.

In a book published in 1694, called "Mercury, or the Secret and Swift Messenger," by John Wilkins, "late Lord Bishop of Chester," there is the following paragraph: "There is a smaller sort of pigeon of a light body and swift flight, which is usually made choice of for such particulars; and therefore the kind of them is commonly called by the name of carriers." The description "light body" could not be applied to the true carrier even in those days. The reverend author was evidently not a pigeon fancier.

[4] This is sufficiently proved in "The Variations of Animals and Plants under Domestication," by Darwin. Moore also states "the original of these pigeons came from Bazora in Persia."

pigeons that were employed as messengers in that country some 700 years ago, the English show carriers of to-day have long since completely lost the attributes which gave them their name. Like all highly developed fancy breeds they are often delicate, and are deficient in the strength, the intelligence, and the vigorous constitution necessary in a messenger pigeon. They may be recognized by the great length of face and beak, and by enormous excrescences, called wattle, at the base of the beak and round the eyes. We know, however, that the strikingly peculiar appearance of the present show carrier is due to careful breeding by English fanciers, and existed to a very modified extent in the original imported bird.[1]

The pigeons used at the present period throughout Europe as messengers are called by English pigeon fanciers "Homers" or "Homing Antwerps." The French, Italian, and Portuguese call them "Messenger Pigeons." The Germans apply the term "Brief-Taube" to them, and the Belgians have called them "Pigeons Voyageurs" for over half a century. It may be argued—and with some show of justice—that the Homer's proper appellation is "The Flying Carrier," a distinction to which the fancy carrier cannot pretend. Be that as it may, I have preferred, in the presence of this established unfortunate misnomer, to follow the example of our foreign neighbours, and to apply the term "Messenger Pigeon," as most suitable to these hardy little travellers.

The large number of messenger pigeons now spread over Europe may be said to be of a general uniform type, although considerable variations sometimes exist in different individuals of the breed, especially to the critical eye. They are all descendants of the "Pigeon Voyageur" of Belgium. The Persian carrier, said to have been first brought to Europe by Dutch sailors, is probably the original progenitor of the species. In Holland, where we shall see pigeons were first used in Europe as messengers in war, the Eastern carrier must have become more or less crossed with local breeds, and its flying properties chiefly considered. From Holland the mixed breed in all probability found its way into Belgium, and its blood was thus infused amongst Belgian pigeons.[2]

It is hardly necessary for me to remind you that a pigeon cannot be taught to "fetch and carry." No amount of training will make him fly in any direction but that in which he believes his home to be. It is for man to adapt to his own ends, to utilize for his own human purposes, the extraordinary tenacity with which the domestic homing pigeon seeks to regain his loft.

[1] The gradual development of these fancy points is traced by Darwin in his "Variations of Animals and Plants under Domestication." The original Persian carrier was somewhat similar in appearance to our English "Dragon" pigeon.

[2] Dr. Chapuis, in "Le Pigeon Voyageur," does not go so far back as this. He thinks that the "Pigeon Voyageur Belge" is the result of a cross between the French owl pigeon, the short-faced, thick-beaked "Pigeon Camus" and the English Dragon. The Antwerp Camulet—a high-flying Tumbler—is usually held to be one of the crosses used in the production of the Voyageur. It is curious that the Dragon, which is clearly a descendant of the Persian Carrier, should have been used by the Belgians to improve their breed of voyageurs.

The employment of pigeons for transmitting intelligence may be traced back to a very early period. The use of the dove by Noah points to a knowledge of its habits and peculiarities. Anacreon, in the sixth century before the Christian era, wrote an ode in which he alludes to pigeons having been used for transmitting love ditties to beautiful damsels. The early navigators of Egypt, of Cyprus, and of Candia are recorded to have used pigeons when they neared their native shores to advise their friends of their return. Varro, who died twenty-eight years before the Christian era, alludes to their employment as messengers from the Olympian Games. Pliny, the soldier, the naturalist, and the historian, is the earliest author who records the application of their use to military purposes. He informs us that during the siege of Modena, B.C. 43, Consul Hirtius, advancing to the relief of his colleague Decimus Brutus, who was besieged in Modena, communicated to him by means of a pigeon.[1] He adds, "Many are mad with the passion of these birds, and build towers for them on the roofs of their houses, and speak with pride of the long pedigree of each."

It is evident, therefore, that the Romans utilized pigeons as letter-carriers. Some writers assert that by this means Julius Cæsar became acquainted with surprising rapidity with the risings in Gaul, and was able to throw his legions into the disaffected districts at the first signs of revolt.

The wars of the Middle Ages, especially the Crusades, afford several examples of the successful application of pigeons for the transmission of messages. About the middle of the twelfth century Nour-Eddin, Sultan of Bagdad, added largely to his dominions by his conquests in Syria and Egypt. When his Government was firmly established in his newly acquired territory, he ordered that pigeons of a certain breed were to be kept in all castles and in all the strong places of his dominions. Towers were built at intervals over a large portion of the country to serve as pigeon houses. In 1167 he originated a system of communication by pigeon between Bagdad and all the important towns of Syria. This organization was afterwards completed and extended to Egypt. A regular service was established between Egypt and Syria.

The central station appears to have been fixed at the palace of Cairo. From that point radiated lines of pigeon stations towards Alexandria, towards Damietta, and towards Gaza. This last town communicated with Jerusalem, Damascus, Bagdad, and Aleppo. The distance between stations varied considerably, but the average, according to Dr. Chapuis, was 50 miles.

The institution of these State pigeon establishments was considered

[1] Quin et internuntiæ in rebus magnis fuere, epistolas adnexas earum pedibus, obsidione Mutinensi in Castra Consulum Decimo Bruto mittente. Quid vallum, et vigil obsidio, atque etiam retia omne prætenta profuere Antonio, per cœlum eunte nuntio? Et harum amore insaniunt multi: super tecta exœdificant turres iis, nobilitatemque singularum et origines narrant vetere jam exemplo. L. Axius eques romanus ante bellum civile Pompeianum denariis quadrigentis singula paria venditavit, ut M. Varro tradit. Quin et patriam nobilitavere, in Campania grandissimæ provenire existimatæ.

of so much importance for the public safety and tranquillity, that large sums were annually assigned to their maintenance. This pigeon post was kept up, with but little interruption, till the year 1258, when it became neglected, owing to political disturbances in Bagdad.[1] On several occasions it rendered signal service to the Syro-Egyptian Empire. During the siege of Acre by Richard Cœur de Lion (1189—1191), the town kept up a constant communication with the Sultan Saladin by this means. The news of the landing of Saint Louis and his crusaders at Damietta, in 1249, was conveyed by pigeon to Cairo and to other towns of the Empire. Joinville writes:—"The Sarassins communicated to the Soudan by means of *Coulons Messagers* that the King had arrived."

Many of the old pigeon stations of Egypt appear to have been in existence up to the end of the last century,[2] and one of the last of them, in the garden of Kiamil Pasha in Cairo, is said to have disappeared in 1801.[3] Voltaire states that he was assured on unimpeachable authority that the ancient custom of pigeon flying is still in vogue in Persia, in Arabia, and in other Asiatic countries where telegraphs do not exist.

The siege of Candia by the Venetian Admiral Dandolo, at the beginning of the thirteenth century, is said to have been materially shortened by the receipt of messages brought by these birds from the island.

The first messenger pigeons brought to Europe were probably Persian carriers, "being sometimes brought by shipping and sometimes in the caravans."[4] When the Spaniards under Frederick of Toledo invested the Dutch town of Haarlem in 1572, the besieged received communications from the Prince of Orange at Delft (some 30 miles distant) by means of pigeons. At the Spanish siege of Leyden in 1574, the Prince of Orange communicated with the Burgomaster of the invested place in a similar manner. The garrison was on the point of surrendering when a message reached them by pigeon that the dikes of the Meuse and of the Yssel had been cut by order of the Prince. The receipt of this communication saved the place from falling into the hands of the enemy, and the Prince of Orange, in recognition of the important services of the pigeons during that memorable siege, ordered that they should be fed at public expense, and, after their death, they should be preserved and kept in the Town-hall.

The bombardment of Antwerp in 1832 supplies another example of the successful use of pigeons as messengers in war.

Carrier pigeons have also their history amongst the Chinese. Sir

[1] This account of the Syro-Egyptian Pigeon System is taken from "Le Pigeon Messager," by La Perre de Roo, and from "Le Pigeon Voyageur," by Dr. Chapuis. These authors got their information from the writings of M. de Volney.

[2] Alexandria and Cairo appear to have communicated by pigeons with Aleppo as late as 1745; see "Le Pigeon Messager," p. 38.

[3] Mr. Borg, H.M. British Consul at Cairo, informs me that pigeon lofts were first built there in 1173, and that the Egyptian stations were some 12 miles apart.

[4] Moore's "Columbarium," reprinted from the original edition of 1735 by W. B. Tegetmeier, 1879.

John Maundeville, knight, warrior, and pilgrim, who penetrated to the border of China in the reigns of the second and third Edwards, writes:—"In that Contree and other Contrees bezonde whan . . . . men holden sege abouten Cytee or Castelle, and they withinner dur not senden out messagers with lettere . . . . they maken here letters and binden them to the nekke of a Colver and letten the Colver flee, and the Colveren be so taughte that they fleen with the letters to the very place that men wolde send hem to."[1]

We are also informed in "The Natural History of the Island of Hainan" by Swinhoe, that pigeons are still used in China as letter-carriers.[2]

Taking leave of the consideration of the employment of pigeons in former centuries, let us pass to their utilization in modern times.

Siege of Paris, 1870-71.

The most interesting chapter in the history of the messenger pigeon is that which records its services to the French during the siege of Paris. It became evident, immediately after the capitulation of Sedan, that the French capital would shortly be invested. There existed in France at that time several pigeon flying societies, some in Paris and some in the provinces. These societies were well aware of the use that could be made of their birds in case of a siege. On the 2nd September, 1870, Monsieur V. La Perre de Roo, an eminent Belgian ornithologist, and one of the most experienced breeders of homing pigeons in Paris, wrote to the Minister of War suggesting that all trained pigeons belonging to Paris should at once be collected and sent into the provinces, while as many as possible should be got into Paris from different parts of France.[3] On the following day, however, the Imperial Government was upset, and no notice was taken of the letter. The German advance on Paris continued, and Monsieur Cassiers, President of the Pigeon Society, "L'Espérance," of Paris, sought a personal interview with General Trochu, to offer the services of the trained birds belonging to members of his Society. In the absence of the General, he was received by a subaltern Officer, who intimated that his proposition was ridiculous, and bowed him out politely. When the Germans arrived under the walls of Paris, not a single pigeon had been sent out of the capital. It seemed, therefore, impossible to receive any news from the provinces. Eight hundred birds belonging to various Columbarian Societies in the north of France had, however, been brought into Paris before the investment, and were housed in the aviaries of the Natural History Museum. These proved most useful as messengers, and were for some time the only means by which the invested capital communicated with outer France. On 23rd September the first balloon

[1] The Penny Cyclopædia, "Columbidæ."

[2] "The Homing or Carrier Pigeon," by W. B. Tegetmeier, 1871.

[3] See "Le Pigeon Messager ou Guide pour l'élève du Pigeon Voyageur," by V. La Perre de Roo. Paris: Deyrolle Fils, 23, Rue de la Monnaie.

("The Neptune") left Paris, carrying a large number of official and private documents. There was no means of ascertaining whether the balloon had landed safely and clear of the enemy. At the suggestion of Monsieur Van Rosebeke, the Belgian Vice-President of "L'Espérance," the next balloon ("The Ville de Florence") that started from Paris with despatches on 25th September, at 11 A.M., also carried out three pigeons. At 5 P.M. the same day the birds had returned with the message, "We landed safely at Vernouillet, near Triel. We will take official despatches to Tours. Bags of letters will be distributed." This was the first message that reached Paris after the arrival of the Germans. The Parisians, the large majority of whom had never before heard of the capabilities of pigeons, were amazed at this unexpected success. The illustrated papers were filled with drawings of the wonderful messengers, and printed fabulous tales of their performances. Nearly every balloon that left the capital after this date carried out pigeons.[1]

The fifth balloon, which started on the 7th October, carried out Monsieur Gambetta, to whose care some of the best pigeons in Paris were confided. On the following day at 5 P.M. one bird returned with the news that the balloon had safely landed beyond the reach of the enemy. This bird was probably the best in Paris, having won the first prize in a race from Auch (600 kil. from Paris) in which there were 1,600 starters. (During the siege this pigeon entered Paris four times with despatches.) None of the other birds confided to the care of Monsieur Gambetta ever returned, although they were known to be of unusual excellence.

On account of these and other losses of good birds, Monsieur Rampont, the Postmaster-General in Paris, determined to entrust the precious winged messengers to the care of persons who understood their management, and not to trust them to aëronauts who were unaccustomed to handle them, who often liberated them in the evening, perhaps with an adverse wind, when the bird had 120 miles to fly home, and sometimes in fog or rain, instead of waiting till the weather improved.

Messieurs Cassiers, Van Rosebeke, Traclet, Thomas, and Nobécourt accordingly left Paris in five successive balloons between the 12th October and the 18th November, and they all eventually reached Tours with the pigeons of which they had charge, except Monsieur Nobécourt, who was made prisoner by the Germans. Six birds belonging to him returned to Paris, each bearing a false despatch attached by the enemy who had captured them. There was, however, no difficulty in detecting the deception, on account of the manner in which the messages were attached, and of the signatures appended.

[1] Dr. Chapuis states that each of the 64 balloons that left Paris, except "The Neptune," carried out baskets of pigeons. The maintenance of the pigeon post was thus dependent upon the departure and successful landing of the aëronauts. No other French town could have furnished materials for these balloon expeditions, and no other beseiged place had any communication either way with the exterior. "Les Postes et les Telegraphes pendant la Guerre," by F. F. Steenackers, formerly Director of Posts and Telegraphs, has been chiefly used in writing this account of the work done by the Paris pigeons.

To employ several pigeons simply to announce the landing of a balloon was a waste of valuable messengers, which was very ill-advised, and the practice was soon put a stop to. Orders were given that all birds sent out of Paris in balloons were to be taken direct to Tours, by special train if necessary, and on arrival there were to be placed at the exclusive disposal of the Delegation.

A large room at the Prefecture of Tours, from which the furniture was removed, was fitted up with perches, &c., and converted into a pigeon loft. In this loft were placed all the birds that arrived (by balloon) from Paris. It was under the charge of Messieurs Cassiers, Van Rosebeke, and the other colombophiles who, as we have seen, had been sent out of Paris for this duty.[1] Monsieur F. F. Steenackers was Director-General of Telegraphs and Posts (including pigeons) at Tours. Birds selected for the journey into Paris were taken by train (express or special) in the early morning from Tours to the furthest point north that could be safely reached, thus reducing as much as possible the distance they had to fly. For some time Blois was a favourite point of departure.[2] While the Government was at Tours, from middle of September to 11th December, 219 pigeons were tossed, and although the majority of the birds were lost, some copies of all the despatches they carried reached Paris. The average number of birds liberated each time was about five, all of which carried copies of the same despatches. From the time of the removal of the seat of Government to Bordeaux,[3] the difficulties of the pigeon post increased enormously, on account of the greater distance to be flown and the severity of the weather. From 11th December to 2nd February (the date of the capitulation of Paris), 83 birds were tossed, but very few of them ever reached the capital. 363 pigeons were sent out of Paris in balloons, of which 302 were liberated; the deficit of 61 being due to illness, deaths, and to the number at first tossed by aëronauts. Out of these 302 birds, only 73 reached Paris with despatches, viz., 9 in September, 21 in October, 24 in November, 13 in December, 3 in January, and 3 in February.[4] Besides these, several arrived with no despatches attached.

As, however, some birds performed the journey more than once, there were but fifty-seven pigeons that actually accomplished the task that

[1] The composition of the staff was as follows: Monsieur Godeaux, Head of Extraordinary Correspondences, resigned 23rd October, and succeeded by Monsieur Feillet; Monsieur De Lafollye, Inspector of Telegraph Lines, in charge of communications by pigeons; Georges Blay, Auguste David, duties were to liberate the birds as near Paris as possible; Messieurs Cassiers, Traclet, Van Rosebeke, and Thomas, in charge of the birds and of the expedition to the place of liberation.

[2] Blois to Paris is about 100 miles, Tours to Paris about 130 miles, Poitiers to Paris 180 miles.

[3] Whilst the Government was at Bordeaux, the pigeons were kept in a specially prepared room at the Prefecture at Poitiers.

[4] These figures are taken from Monsieur La Perre de Roo's book. The "Bulletin de la Réunion des Officiers" of 11th July, 1885, gives the following table of results which is not identical with Monsieur La Perre de Roo's figures:—

was set them.[1] Neither can we be astonished that the losses were so numerous. Many of the birds used were reliable and well trained, and these were the ones which rendered a good account of themselves. One bird was taken out of Paris six times, and flew the return journey after each balloon trip. One of Monsieur Van Rosebeke's birds returned four times, and another three times. At least two birds are reported to have reached home badly wounded. The majority of the pigeons placed at the disposal of the Government at Tours and Bordeaux were, however, untried and almost useless. Thus Monsieur La Perre de Roo states that from the 26th October to 12th November not a single bird reached Paris, because during that time a lot of pigeons were used that were quite untrained, but which the person in Paris to whom they belonged had insisted on placing at the disposal of the Government.

One great obstacle to the success of the pigeon post into Paris was the weather. It is quite useless to liberate birds on very thick and stormy days, a consideration to which the Government at Tours and Bordeaux paid little or no attention. In the report of Georges Blay, who had charge of the liberation of the birds, passages such as this frequently occur: "In spite of the bad weather we liberated the pigeons in accordance with your orders. There is no chance of the birds making Paris." The winter of 1870–71 was exceptionally severe. The ground was often covered with snow, which confused the birds in their efforts to find their way home. The cold was intense. Fogs were of frequent occurrence. The days were short. Added to this, the pigeons were exposed to the pursuit of hungry birds of prey, and to the unceasing attention of the enemy; for if several of them returned home wounded many doubtless were fatally hit. It is also a fact that pigeons bearing despatches were shot by French peasants, who were totally ignorant of the important services the birds were rendering to their country. Monsieur La Perre de Roo states that at Blois six pigeons with despatches were killed by a French peasant, and Monsieur Steenackers mentions another instance of destruction.

A decree was issued from Bordeaux rendering any person who killed a pigeon carrying despatches liable to imprisonment for a

Date.	Number of birds liberated.	Arrived in Paris.
September and October	105	22
November	83	17
December	49	12
January..................	43	3
February.................	22	3
Total	302	57

[1] "The Bulletin de la Réunion des Officiers" gives a lower figure.

period of from three to five years.[1] Liberal rewards were given for the restoration of pigeons which had been caught after having lost their way. The sum of 240 francs was paid to a peasant who restored to the Government at Bordeaux a bird captured with its messages intact.

Pigeons began to be collected at Tours from the beginning of October, from which date they were regularly employed as messengers into Paris. It was not, however, till the 4th November, by which time 115 birds had already been used, that the advantages of the pigeon post were opened to the public. On that day the Delegation of Tours issued a decree to this effect: "Considering that since the investment of Paris there has been established, through the agency of the double service of telegraphs and posts, by means of balloons leaving Paris and of messenger pigeons leaving Tours, a special interchange of correspondence destined to supplement between Tours and Paris the ordinary means of communication, which for the time being are interrupted. . . . Every person residing within the Republic is permitted to correspond with Paris by means of the messenger pigeons belonging to the Administration of Telegraphs and Posts, the charge to be 50 centimes per word."[2]

It was further notified that telegrams for Paris would be received at all the postal telegraph stations of France (not in occupation of the enemy) and transmitted by telegraph or post to the point of departure of the pigeons (Tours). Such telegrams were to be in French and in clear and intelligible language without any signs or conventional figures. The contents to be of a purely private character; information concerning the progress of the war and allusions to politics were forbidden. The maximum number of words was limited to twenty. The arrival of the messages in Paris was not guaranteed. On the 16th November the regulations on the subject were issued from the General Post Office in London, and messages could be sent from any part of the United Kingdom, *viâ* Tours, into Paris. These arrangements made a considerable impression on the French public, who for the past seven weeks had been debarred from communicating with their friends and relatives in Paris, and within a few days an enormous number of telegrams for the capital arrived at Tours.

In the meantime important progress had been made in the method of transferring telegrams, &c., to the necessarily small despatches that

[1] This decree was as follows: "Whosoever, during the continuation of the war, shall hunt, destroy, or attempt to destroy, outside its pigeon house, by any means whatsoever, such as firearms, catapults, or hawks, a pigeon of any breed whatsoever, shall be liable on conviction to imprisonment for a period of not less than one month or over six months. If it be proved that the accused knew that the pigeon was carrying despatches, or was intended to be used as a messenger, the imprisonment awarded shall be from three years to five years. The person on whose evidence the conviction shall have been obtained shall be entitled to remuneration of not less than 50 francs or more than 100 francs, in accordance with the decision of the Court, and which is to be included in the costs awarded against the person convicted," &c. This decree is dated Bordeaux, 23rd January, 1871.

[2] This charge was reduced to 20 centimes on 8th January. On 25th November, a system of reply cards was introduced, and a Post Office order service was approved of.

were carried by the pigeons. At first the despatches carried by the birds were written by hand on small pieces of very thin paper and on one side only, a numeric cypher being often used. This is the most simple and primitive method, and was in operation till about the middle of October. It was, however, long and toilsome, and quite unsuited to the transmission of the enormous number of despatches which had to be sent into Paris. Each despatch had to be copied several times, and errors often crept in. It was then suggested by Monsieur Barreswell, an eminent chemist of Tours, to reduce the size of the despatches by photographing them, and thus at the same time secure a large number of copies without risk of errors. The despatches were accordingly first copied in handwriting in large characters, then pasted one under the other upon large sheets of cardboard. These large sheets were then fixed to wooden panels about 2 feet by $3\frac{1}{4}$ feet (65 centimetres by 1 metre), and the panels thus covered with two or three columns of messages were photographed and reduced to $1\frac{1}{2}$ inches by $2\frac{1}{2}$ inches (4 centimetres by 6 centimetres), a reduction of $\frac{1}{300}$ in surface.[1] The photographs were on very thin paper, and on one side only. They were checked under a microscope before being confided to the pigeon.

Amongst the despatches were several cuttings of the "Moniteur" newspaper, which at once demonstrated how much more considerable the reduction would be if all the despatches were printed before being photographed. The next step in advance was therefore to set up the despatches in type and to photograph them on each side of the small paper messages. The first official messages thus printed are dated the 9th November, but the result had been attained some time previously to this, and it was chiefly on account of the facilities this afforded that the pigeon post was open to the public on the 4th November. By that date twenty-two tablets of official despatches had been photographed, twenty copies of each having, on the average, been struck off, and up to the 11th December (the day on which the Delegation moved from Tours to Bordeaux) nearly fifty of these official tablets had been photographed.[2]

About the middle of November, Monsieur Dagron, a well-known microscopic photographer of Paris, arrived at Tours with two assistants, having been sent out of the French capital by balloon for the purpose of assisting in the photography of the messages. Soon after the transfer of the Delegation to Bordeaux, Monsieur Dagron's new system came into operation. His reduction in surface was much more considerable, and the messages were photographed on a very thin film of collodion. Although necessarily photographed on one side only, each of these films or pellicles contained on an average

[1] Each of these pigeongrams could contain 150 despatches averaging 16 words each. One bird could carry six of these, making 900 messages.

[2] To these must be added 16 tablets, each containing 6 columns of private messages. These 6 columns contained about 613 messages, averaging 16 words each. As the messages attached to the birds were photographed on both sides, there was a total of 1,226 messages on each pigeongram of about 4 square inches. Monsieur de Lafollye in his report states that 9,800 private despatches and 43 full sheets of official despatches, all reduced by photography, were sent from Tours into Paris, and that the greater part of them arrived at their destination.

2,500 despatches. One bird could easily carry a dozen of these pellicles, making 30,000 despatches. Sometimes this number was exceeded. For instance, a pigeon which arrived in Paris on the 3rd February carried eighteen pellicles which contained 40,000 messages, most of them private.[1] This was the largest number carried. Each pellicle was sent so as to ensure arrival on several birds, some only three times, others up to thirty-nine times, the average being about twenty.[2]

The "Bulletin de la Réunion des Officiers" (11th July, 1885) states that "150,000 official despatches and one million of private despatches or notices of money orders were carried by pigeons into Paris.[3] These messages if copied in ordinary writing would fill 500 library volumes. The postal orders amounted to 190,000 francs (7,600*l.*)."

The method of attaching the messages to the birds is always of importance, and had not been studied before the siege. At first the paper message written by hand was simply rolled up tight, waxed over, and attached to a feather of the tail. It was soon found that the thread which kept the message in its place cut or damaged the paper, and so in order to protect the despatch from this, and being pecked by the pigeon, from damage by wet, &c., the paper message was inserted in a small goose quill 2 inches long. The tube was then pierced close to its ends with a red-hot steel point so as not to split it, and in the holes thus made, waxed silk threads were inserted to fix it to the strongest feather of the tail.[4]

The birds were stamped on the wing feathers with numbers, the first number indicating the number of birds sent, the second the number of the series of messages, and the third the number of pigeons remaining.

In Paris the Administration of the Posts placed a sentry on each

[1] The greater number of these pellicles contained messages that had been previously sent by other birds into Paris, but the receipt of which had not been acknowledged.

[2] The weight that can be carried by a pigeon is an important matter. The weight in messages carried by one bird into Paris was always under 1 gram (15½ grains). In America newspaper reporters attach to one pigeon twelve sheets of very thin manuscript, each sheet being 9¼ inches by 7 inches. These sheets are folded and made into a roll nearly 5 inches long. This roll is attached to two tail feathers by means of thin copper wire. The weight of the pigeongram and wire is 96 grams. In England this weight has been considerably exceeded. Pigeons have been used to carry a whole page of a daily newspaper weighing ¾ of an ounce (360 grains), tightly rolled up, and hung by a loop around the neck. Birds are regularly employed in this service between Alton and Rotherfield Park, a distance of five miles.

[3] The service of post office orders was established on 25th November. Monsieur De Lafollye states in his report to Monsieur Steenackers that, during the siege, 95,581 private telegrams of all sorts, representing a value of 432,524 francs 90 centimes (173,000*l.*), were carried by pigeons into Paris. Of these over 60,000 arrived. Monsieur La Perre de Roo estimated the number of official despatches at 115,000.

[4] Monsieur Georges Blay was the originator of this idea. At the Museum of the Zoological Gardens at Antwerp there is a stuffed pigeon that belonged to Monsieur Cassiers, and which flew into Paris with messages. The quill is attached to a tail feather.

pigeon loft that had furnished birds for Government use. When a messenger bird arrived the owner was conducted under escort with his pigeon to Monsieur Chassinat, Postmaster-General, who detached the messages.

The first despatches which arrived in Paris were, as we have seen, written by hand.[1] They were read by the naked eye or with the assistance of a microscope. To these succeeded the photographic ones on paper, to decipher which a powerful microscope was essential. When, however, the collodion pellicles began to arrive, a more rapid means of reading them was adopted. Being transparent, they were placed between two pieces of glass put into a species of electric magic lantern, and the writing was thrown in large legible characters on a screen or wall. This was copied by several clerks at once, each taking one column of writing, and in this manner the transcription and sending out of the messages was rapidly accomplished.

In spite of many shortcomings the Paris pigeons performed valuable services. Not the least of these was the conveyance from time to time of news from relatives and friends outside, and the occasional gratification of the intense desire for communication with the rest of the country from which the besieged suffered.

The organization of regular "Military Pigeon Systems" in almost every Continental nation of Europe soon followed the Franco-German War.

The uses to which the birds are put are not however limited to cases where no other methods can be put into practice. In war time the stress of work on telegraph lines and on military signallers will be relieved by this means.

The organization of all foreign military pigeon systems is based upon the same guiding considerations.

The frontier fortresses, especially those that are considered most liable to attack, and a large number of inland towns both open and fortified, are provided with pigeon lofts. An important point in the interior of the country—usually the capital—is selected as a central station with which all other stations are to communicate. There is often also direct communication between fortresses. When the distance separating outlying stations from the central one is considered too great, the connection is ensured by means of intermediate ones. It is also sometimes convenient to resort to this last arrangement in order to reduce the number of birds that must be kept.

The strategical and other considerations which influence the selection of stations will be best appreciated by following on the accompanying map the description of the French or German system.

The number of birds in each station varies with its position, the

[1] Amongst instances of the satisfactory working of the pigeon post, the following are worthy of record, and are mentioned by Monsieur Steenackers. Being short of chemicals required in his photographic processes, Monsieur Dagron, who could not obtain them in Bordeaux, sent for them by pigeon to a firm of chemists in Paris. The bird was liberated at Poitiers on the 18th January, reached Paris the same day, and on the 24th January the chemicals required were delivered to Monsieur Dagron at Bordeaux, having been sent out of the capital by balloon. The news of the French victory of Coulmiers reached Paris the day after the action.

distances that have to be flown, and the number of directions in which the pigeons have to be trained.

A single section station, that is, where the birds are only intended for use in one direction, should have about 200 birds. 150 birds may be added for each section after the first. Thus, for instance, a station at which birds are trained to fly in three directions should have 500. These are sufficient to ensure communication for six months in case of siege. The calculation is arrived at somewhat in the following manner. Suppose the communication is, on an average, to take place twice a week; then in 6 months (26 weeks) 52 liberations would be necessary. The number of birds liberated on each occasion may be taken to average 3, or a total of 156 for the 52 tosses. Making allowance for various contingencies, it may be laid down as a general rule that the smallest military pigeon station should consist of about 200 birds.

All foreign Governments are however able to modify these figures to the benefit of the exchequer. Under the fostering care of the War Ministers, private pigeon flying clubs have within the past twelve years enormously increased in every part of the Continent of Europe. In Germany there are at the present time some 350 such societies, while in France the number may be estimated at 300. The greater number of these fly their birds in directions fixed by the War Minister, who gives prizes for many of the races. The military authorities can therefore rely upon the services of many thousand privately-trained birds to supplement the work required of the military lofts. In the possession of these pigeons each nation has at its disposal an ever-ready means of general intercommunication, which in time of invasion may be beyond price, and which has been established, and is maintained, at comparatively small cost.

When invasion threatens an interchange of birds takes place: the messenger pigeons are kept confined in their temporary home until their services are required. When a despatch has to be sent to another station, birds belonging to that station are selected, the despatches are attached to them and they are liberated. When properly trained birds are employed, their return to their own loft may be looked upon as almost certain, unless the weather is sufficiently bad to render flying impossible.[1]

M. H. J. Lenzen, of Cologne, the chief adviser of the German Government in all matters relating to pigeon communications, makes the following observations on the organization of a system, in his book "Die Brieftaube." "It is sufficiently established that pigeons have been used in the service of the god of war to carry news, despatches, &c., to invested places. Such communications might be of the utmost importance, if, for instance, they related to the relief of a fortress, or the timely organization of a sortie. It might, indeed, occur that this method of communicating was the only one left open to the public by which their private correspondence could be maintained, and this circumstance alone not only is sufficient to warrant the establishment of pigeon stations, but should engender a more

---

[1] The judicious selection of birds is important. Some birds are remarkable for their reliability in bad weather, others for their rapidity under favourable atmospheric conditions.

lively interest for this branch of ornithology, and more affection and care amongst the public at large, but more especially amongst the inhabitants of fortified places. The inhabitants of Paris are well able to appreciate the benefits resulting from direct communication being maintained between an invested place and the outside world. Balloons can indeed secure communication in an outward direction, but the bringing in of news when the telegraph is cut can only be effected by means of messenger pigeons; besides, the direction that a balloon will take can never be depended upon, and the bold aëronauts often fall into the hands of the enemy, with their valuable cargo of despatches, &c., in spite of the sympathy of their own countrymen, or they may even be committed to a worse fate. Pigeons which are intended exclusively for ultimate military purposes can be used, as already stated, either for bringing communications—official or private—from outside into a town, or for carrying despatches out. Their services may also be required to carry on correspondence from occupied districts to the seat of Government elsewhere, and *vice versâ*. In such a case the birds would, as it were, be secret messengers playing the part of spies.[1] Their work would be of unmistakable importance when an occupied country was either completely shut off from all news, or only received information which had filtered through the enemy, and which was consequently imperfect and unreliable. This latter *rôle* of messenger pigeons may be considered as of equal importance with the first.

"For the proper carrying out of the scheme it is in the first place necessary that the frontier fortresses and all towns in the interior, whether fortified or not, be furnished with pigeon lofts. It is a question for the careful consideration of the authorities, whether public buildings or private ones are most suited for the positions of lofts in fortresses. The fact that in the case of a siege the public buildings would be the first destroyed, is an argument against placing them there. Suppose a bird with despatches returned and found its home destroyed or gone! It would fly about as a wanderer with the despatches, and that particular part of the system would collapse during the war. In the case of an occupation by an enemy, the lofts and the pigeons would fall into the hands of the enemy. The best course would be to induce or encourage pigeon fanciers in towns (and there are always many to be found) to keep pigeons, and to cultivate the sport of pigeon flying in the same manner as is done in Belgium. In this manner the country would soon be in possession of thousands of pigeons, which could be placed at the disposal of the State in case of national danger, as happened in France. In the Imperial provinces of Alsace and Lorraine the whole task would for the present devolve upon State officials. Furthermore, it would be necessary that all birds be trained, in the interests of the State, in directions fixed by the latter: for example, those of the western frontier places towards the centre of the country, viz., Berlin, and those belonging to Berlin, Magdeburg, and Stettin towards the west. At the outbreak of hostilities the pigeons of the frontier fortresses would be taken into the interior, the best trained and most reliable being sent to the more remote fortresses and open towns, and those with less training to the nearest places. In case of danger threatening any of these places, the birds must be sent further into the interior, but never further than their previous training may warrant. These pigeons will be employed to carry despatches to the commanders of besieged towns, as well as the latest and most reliable news to official persons in the occupied parts of the country. The most important *rôle* will, however, devolve upon those birds that have been taken into the frontier places from the interior of the country. They can, especially if the fighting ground is our own country, carry reports concerning positions, &c., faster than the most speedy mounted messenger, or even than the telegraph. . . The system must be so organized that the commandants of fortresses and the official persons of towns be furnished with an accurate list of the pigeons that can be placed at their disposal. To avoid mistakes, the pigeons from different towns should be kept in different lofts, or in some other way be kept separate.

[1] Hence the necessity of searching for pigeon lofts in occupied districts. An invader might not only prevent the enemy from using such lofts, but might employ the birds very much to his own advantage. A series of lofts at intervals along a line of advance would be a most valuable acquisition.

amongst
l places.
ng from
outside
but the
neans of
ever be
ny, with
eir own
hich are
stated,
a town,
carry on
ere, and
playing
when an
received
equently
nsidered

ary that
not, be
n of the
he posi-
uildings
Suppose
It would
e system
emy, the
t course
e always
lying in
uld soon
sposal of
Imperial
lve upon
d, in the
e of the
nd those
outbreak
interior,
and open
threaten-
ut never
mployed
test and
ry. The
en taken
ecially if
ons, &c.,
ph. . .
he official
t can be
nt towns

---

cts. An
t employ
s along a

Journal R.U.S. Institution
Vol. 30.

THE MILITARY PIGEON SYST

THE "HOMER" OR "MESSENGER PIGEON."

Harrison & Sons Lith.

ON SYSTEMS OF CENTRAL EUROPE. Plate VI

Harrison & Sons Lith. St Martins Lane W.C.

"In the employment of pigeons as military messengers it must be borne in mind that the first consideration is the safe arrival of the message. In view of the obstacles which are met with in the German Empire (such as mountains and forests) the stations should not be too far apart. A distance of 90 to 120 miles may be fixed as a reasonable limit. With such moderate distances the pigeons can be used in unfavourable weather, and when their journey is but 90 miles, they can be liberated in the summer as late as six o'clock in the evening, as they can traverse such a distance in two hours at the outside. All stations should be put into communication with a central station (which in Germany is Berlin), and such a connection can most easily be ensured by means of intermediate stations. A further advantage will result from this arrangement, viz., that in a period varying from one to two years, a perfectly organized post can be established; for young birds in their first season are able to fly 90 miles, while the long journeys of 360 miles can be accomplished by only a portion of the old birds in their third season.

"These considerations have determined the directions of the pigeon races from Berlin, and from Basle, Strasbourg, &c. Special care must be exercised at a station in the identification of birds that are trained in different directions. This can only be ensured by stamping the birds with a number and the name of their route, such as 'Cologne-Metz,' 'Cologne-Berlin,' and entering these particulars in a register kept for the purpose, so that when an exchange of birds takes place preparatory to their employment, they can readily be picked out owing to their previous stamping. Since, as long as the war lasts, the pigeons cannot be expected to return to their station at any certain intervals, it is essential that every bird should signal his arrival. This can be done by means of a trap attached to the entrance of the loft, which is described elsewhere."

A description of the different Military Pigeon Systems of Europe will best illustrate the practical application of the foregoing remarks.

France.

The campaign of 1870–71 showed the French how dangerous it is to neglect any factor that may influence the success of military operations, and that elements of success cannot be improvised, but must be prepared beforehand in all their details if the best results are to be attained.

Prior to the Franco-German War it had not been thought necessary to establish any means of communication that could be made available between an invested place and the rest of the country. It was solely due to the existence of two private pigeon flying societies in Paris that any news from the provinces reached the capital during the siege, and this means could not have been employed but for the assistance of balloons.

The work done by the birds during that critical time, under very unfavourable conditions, all other means of reaching the capital having failed, showed the necessity of organizing a regular service of message pigeons for use in war generally, and particularly as a means of communicating over the heads of the enemy with a besieged fortress.

Immediately after the Franco-German War, Monsieur La Perre de Roo was applied to by several of the Continental Powers for instructions relating to pigeon flying. He was asked to undertake the establishment of a military pigeon system in Russian Poland. Although this offer was not accepted, he appears to have given some assistance to

the Czar's Government in the matter. In the meantime he did not cease to represent to the French military authorities the necessity of establishing military lofts, and in 1872 a Commission was appointed to examine the question. The result of its deliberations was—after an investigation of the merits of the various breeds—to recommend the employment of birds that were to be a cross between the "Pigeon Hirondelle" and the Belgian pigeon. Fortunately no notice was taken of this part of their report. These birds were to be entrusted to the care of the Director of the Jardin d'Acclimatation, and their produce was to stock the military lofts of France.

It was not, however, till the year 1877,[1] by which time many other nations had a regular system of pigeon communication in working order, that any further steps were taken. Monsieur La Perre de Roo states in his book[2] "Le Pigeon Messager" that he then "prevailed upon the French Government, only after continuous and persevering efforts, to accept as a free gift 420 messenger pigeons of the best Belgian breed . . . and the descendants of these are intended to stock the lofts which are to be established in all the fortresses of France."

Monsieur Geoffrey Saint-Hilaire, Directeur du Jardin d'Acclimatation of Paris, was charged with the care and breeding of the pigeons which were thus to contribute to the national safety. A handsome four-storied pigeon-house, built of brick and iron, was constructed in the gardens, and became the first French military breeding loft. The next loft constructed was that of Mont Valérien.

There are now ten stations well stocked with working pigeons, and all communicating, either directly, or through intermediate transmitting stations, with Paris. All these are on the eastern or south-eastern frontier.

Commencing from the north the military pigeon stations are as follows:—Lille, Mézières, Verdun, Toul, each with about 200 birds, and communicating direct with Paris, the maximum distance being 160 miles.[3]

No doubt birds are trained to fly between such of these fortresses as are not considered too far apart, but being single section stations with only 200 birds, they are supposed to correspond with one another through Paris.

Belfort and Besançon are single section stations, but being each of them over 200 miles from Paris, they communicate with the capital through Langres.

[1] The "Bulletin de la Réunion des Officiers," No. 29, of 18th July, 1885, gives the date as 1878.

[2] "Le Pigeon Messager, ou Guide pour l'élève du Pigeon Voyageur et son application à l'Art Militaire," by V. La Perre de Roo, Paris. Most foreign military lofts are in the attics of a barrack, and somewhat similar to that of Cologne, which is described in the account of the German pigeon system. Registers containing particulars of every bird are also kept.

[3] The lines of flight shown on the map indicate the services to which the birds are destined in time of war. The training of the birds is not, however, confined to the directions and distances shown. The Langres birds, for instance, are trained as far as Marseilles.

Langres is, next to Paris, the most important central station in the country. It is the direct transmitting station for Belfort, Besançon, and Lyons, and should therefore contain 500 birds.

Lyons is a two section transmitting station communicating with Paris through Langres, and receiving from Marseilles and Perpignan, each of which places has a military loft.

In Colonel v. Löbell's "Annual Reports on Changes and Progress in Military Matters in 1884," the following appears[1] :—"Orders have been given for the establishment of central pigeon post stations at Paris and Langres. These are to be formed on a basis for securing the communication for a period of six months between the more important fortresses. Paris is to communicate with Mézières, Verdun, Toul, and Langres, and the latter place also with Belfort, Besançon, and Lyons. Recruits for the working of these establishments are to be taken exclusively from men who before joining have belonged to a pigeon flying society, and they are to be posted to the 1st Regiment of Engineers at Versailles."[2]

The military budget assigns a credit of 100,000 francs (4,000*l.*) for the annual cost of signalling and pigeon lofts.

In one of our daily papers of the 6th January, 1885, the following telegram appeared from a Paris correspondent:—"The usefulness of carrier pigeons for military purposes is once more demonstrated by the fact that General Campenon has given orders that all the detached and isolated forts on the Alpine frontier be supplied with those birds."

When soldiers are transferred to the reserve, they may take with them a pair of young birds, if they are known to be interested in pigeons. Civilians of approved character may also be given birds if there are any to spare.

In the "Bulletin de la Revue des Officiers" of 18th July, 1885, it is stated that at the grand manœuvres of the 9th Army Corps, private persons lent pigeons which were used as military messengers, and prizes were given for those birds that did the best work.

As in other countries, every effort is made to develop the sport of pigeon flying, and to exercise some control over the directions in which private societies train their birds.[3]

The Minister of War frequently gives prizes for pigeon races in different directions.

The number of private societies has increased very much in France of late years. At the present time there are about 300 such societies. Allowing 500 birds to each, which is a moderate estimate, there

[1] See "Journal of Royal United Service Institution," vol. xxix, No. CXXXI, of 1885.

[2] There is a large military loft at Versailles which, with that at Mont Valérien, may be included among the Paris lofts. It will be observed that all the French pigeon stations are here mentioned except those of Lille, Marseilles, and Perpignan. I find that the Lille loft, which is situated in the "Caserne de la Porte de Paris," still exists, but it now contains no pigeons. At Marseilles the loft is in the Fort St. Nicholas, and contains about 300 birds. The pigeons of Perpignan are trained to Marseilles and to Lyons, those of Langres are trained as far as Marseilles.

[3] The Fédération du Département de la Seine flew last season from Nuits-sous-Ravières and from Dijon. In the latter *concours*, which was for young birds, 742 pigeons were liberated. The Society "L'Épervier," of Paris, fly their birds from Lyons, 380 miles.

would be 150,000 trained private pigeons in France; probably there are a good many more.

At the suggestion of the Général Directeur du Depôt des Fortifications, the Minister of War directed Captain Thomas Caldilhat, of the 80th Territorial Regiment, to visit the principal towns of France in the summer of 1884, to report on their resources in trained pigeons and to act as a connecting link between the military lofts and private societies.

In accordance with the Law of the 3rd of July, 1877, the military authorities have the right to requisition messenger pigeons, but it is not specified in what manner these requisitions are to be prepared. In September last the Minister of War reported to the President of the Republic that it was necessary to issue definite instructions relative to such requisitions. M. Grévy consequently directed that once a year, at the time that horses, mules, and other animals are registered, a census is to be made of all messenger pigeons: the lists are to be made out under the orders of the mayors, upon the obligatory declarations of the proprietors of the birds, failing which an official inspection of any loft may be made.

A recent article in a French military paper[1] on their pigeon system concludes thus: "In a word, all dispositions are made, so that, when a new war breaks out, the service of messenger pigeons will not have to be improvised as in 1870. An exchange of correspondence between the central authority, the governors of fortresses and entrenched camps, and the commanders of armies is ensured. In this respect we are quite prepared."

Germany.

The Germans recognized at once the importance of the services that pigeons rendered to their adversaries during the siege of Paris, and were one of the first nations that established military lofts.

In May, 1872, M. Lenzen, of Cologne, whose past experiences with pigeons entitled him to attention on such matters, was charged with the organization of the military pigeon system of Germany. He at once proceeded to Belgium, where he studied all the details connected with the Belgian lofts, and eventually purchased at Brussels and at Antwerp 300 pairs of first-class birds. These were distributed amongst the four first lofts that were constructed, viz., at Berlin, Cologne, Strasbourg, and Metz.[2] Their number was afterwards increased by further purchases. M. La Perre de la Roo states that at a public sale of *pigeons voyageurs* held at Brussels on the 1st of March, 1874, the majority of the sixty-five birds sold were purchased on behalf of the German Government at an average price of 65 francs per pigeon.

All these Belgian birds were kept as prisoners at the stations to which they were allotted, solely for breeding purposes, and were the stock from which all the military lofts of Germany were supplied.

[1] "Bulletin de la Réunion des Officiers," No. 29, of 18th July, 1885.

[2] "Die Brieftaube," by H. J. Lenzen, of Cologne, published at Dresden, 1873. Price 15 groschen.

Two pigeon houses were erected in the Zoological Gardens of Berlin; each is capable of containing about 500 birds. They were at first intended only as breeding depôts, and were placed under the supervision of Dr. Bodinus, the Director of the Zoological Gardens.

The pigeon loft at Cologne is in the attic of a barrack, and in 1874 it contained 200 birds.[1] The interior fittings are said to be suitably arranged, and every attention is paid to cleanliness, ventilation, &c. As nearly all the German military lofts are thus situated immediately under the roof of a barrack or other Government building, a further description of that of Cologne may be interesting. The floor space is about 16 yards by 11 yards. The interior is divided by wooden lattices into ten compartments which communicate by sliding doors.[2] These doors are usually kept closed, but, in order to allow the birds to pass from one compartment to another, there is a small opening at the bottom. This arrangement is very convenient for catching the birds readily—no small consideration when many have to be sent away for a training fly.

The pigeons are fed twice a day on vetches, and their water fountains are cleaned out every second day.

The nest boxes are on the floor against the wall. In each nest box there is a red earthenware nest pan, in the bottom of which are placed a few fine oak shavings.

Round the sides and front of each pair of nest boxes runs a little wooden fence fixing the boundary of the apartments occupied by each pair of birds.

Over each nesting place is a card showing the index number of the cock and of the hen, the date of laying and of hatching, and the number of young ones. Every pigeon is stamped on the wing with his number and the private mark of his loft.

The commandant of the place is responsible for the birds, that they are properly cared for and trained. A non-commissioned officer is in charge, and under him there is a keeper (who receives 4*l*. 10*s*. per month) and two private soldiers. This establishment is for peace time; in war time it would probably have to be doubled.

The accounts are strictly kept, and are signed by the commandant once a month. A register is kept giving a list of the birds, the numbers stamped on them, their age, sex, colour, and any distinguishing marks.

Another register gives the different places from which each bird has flown, with notes on their rapidity and reliability. It contains complete information on the capabilities of every bird.

The next fortresses that received attention were those at the eastern extremity of the Empire, viz., Königsberg, Thorn, and Posen, all near the Russian frontier.

Other pigeon stations have from time to time been added until the German military pigeon system has become by far the most extensive and complete of Europe.

[1] "Le Pigeon Messager," by V. La Perre de Roo, p. 112.

[2] This description of the Cologne loft is taken from "Le Pigeon Messager." It applies generally to French and German military lofts.

The western fortresses of Cologne, Metz, and Strasbourg each contain at the present moment about 400 trained pigeons, but it is intended to increase the number to 600. Mayence and Würzburg are also well stocked with birds.

Cologne communicates direct with Berlin, a fly of 300 miles, and is a transmitting station for Metz, and perhaps for Mayence. Strasbourg and Metz are both in communication with Berlin through Würzburg. There is an important pigeon establishment at Torgau on the Elbe, which fortress acts as an intermediate transmitting station from some of the western fortresses.

The whole of the northern coast is studded with pigeon stations, which are under the Minister of Marine. They are to be found at Wilhelsmhavn, Tonning, Kiel, Stettin, Danzig, and Königsberg. There is intercommunication between all of these, and they are all in direct or indirect communication with Berlin.

Experiments have recently been made by the naval authorities in homing pigeons on board men-of-war, so that messages may be sent to the ship from the shore. It is said that the birds experience no difficulty in recognizing their own ship amongst a number of others. Such a method of communication may at times be of value, but its application is evidently a good deal restricted.

Thorn is looked upon as a central station of importance, and is said to be prepared for the accommodation of 1,000 pigeons. It is in direct communication with Posen, Königsberg, Danzig, and Berlin. Breslau is also in communication with Berlin by pigeon.

The training is not confined to the lines of flight I have indicated, which are often insufficient to test the qualities of the birds. For instance, the Königsberg pigeons are trained as far as Torgau.[1] Those that will fly that distance are hardy resolute birds that may be depended upon as messengers from shorter distances, even in bad weather.

The stations under the Minister of Marine do not all belong to the Government. That at Danzig was established by contracting with a private individual, the possessor of a large loft, to keep a specified number of birds in training.[2]

The military birds are employed as messengers whenever opportunity occurs. In the manœuvres which take place annually in the neighbourhood of Cologne, the garrison of the place are kept constantly informed of the progress of the operations by this means, and pigeons are also sent direct from the field of operations to Berlin with reports.

The annual credit in the military budget for pigeons and signalling was increased in 1884 from 900*l.* to 1,700*l.*

[1] Königsberg to Torgau is about 390 miles. The training table for this journey is given in the "Militar Wochenblatt," p. 999, of 1884. The distances between the training stages are very similar to those generally adopted in England. The birds are never liberated later than 5 A.M.

[2] I understand, from information obtained from local sources, that the Danzig contractor has recently given up his pigeons, and that there is now only one amateur in that town who keeps homing pigeons, his loft containing about fifty birds. At Stettin the birds are also private property.

Such resources as I have described might be considered sufficient to ensure a regular service of pigeon posts throughout the country in case of invasion. The Government have, however, also at their disposal the services of a large number of private lofts scattered over the whole Empire. Since the Franco-German War pigeon flying has continuously and rapidly developed,[1] until it may now be said to be a national pastime. The number of private societies is estimated at 350, the country enclosed by the western fortresses being most favoured in this respect. The federation of pigeon flying clubs of the outer Rhine numbers seventy societies. The United Federation of Cologne and its environs have issued their training table for 1886, and during the coming summer will send their birds as far as Vienna, about 470 miles.

The Emperor is an active supporter of the sport, and gives gold and other medals every year for races over long distances. Military Officers of high rank attend the meetings of the principal societies. The Minister of War assists, as in other countries, by offering money prizes at some of the *concours*.

With a view to reduce the ravages committed on pigeons by hawks, the Government offered, in 1885, rewards to gamekeepers and others for the heads of any birds of prey.

Austria.

In Austria the application of pigeon flying to military purposes has been very gradual.[2] The first private society is said to have been established in 1873, and the first military one two years later, at Komorn. A second military station was established in 1882 at Cracow. As far as I can learn there are no others in Austria.

Very complete instructions "fur die Brieftauben stationen" were issued by the General Staff, in 1883.

Private societies are evidently relied on to a great extent to supplement the work of the Government birds, and prizes are given annually for races to Vienna and other places. Besides this the Government give, free of cost, the wood required for the erection of a pigeon loft to such Officers and Government servants who will undertake to keep and train the birds, with a view to their use as messengers in case of war.

[1] In 1875 the "Colombia" Society of Cologne had 157 members. In that year it organized nineteen pigeon races. Since that time it has continued to increase in importance, and is now one of the leading German clubs of Germany. At a general meeting of the Rhine societies held at Elberfeld on the 25th October last, seventy-four different societies were represented. The following clubs will take part in the Vienna Concours of 1886:—Union-Cologne, Club-Cologne, Cenobia-Deutz, Fauna-Elberfeld, Columbia-Elberfeld, Brieftaube-Solingen, Brieftaubenpost-Solingen, Concordia-Bonn, and the Brieftaubenzuchter-Verein.

[2] This account of the Austrian pigeon lofts is chiefly taken from an article by Lieutenant Mandry, of the Austrian Field Artillery, which appeared in the "Organ der Militär Wissenschaftlichen Vereine," No. 39, of 1884. See also "Die Brieftaube im Deinst des Krieges," by Lieutenant E. von Scheure, published in "Streffleur's Militarische Zeitschrift," July, 1883, Vienna.

At the end of the breeding season civilians can buy young birds just out of the nest at 50 kreutzers each (one shilling). The railway lines also assist by taking persons at reduced fares who accompany baskets of birds sent by train for liberation.

The Austrian military authorities appear to appreciate the usefulness of pigeons as messengers in mountainous countries, where the electric telegraph might not be able to keep pace with the movements of troops, or where detachments had no other method of communication. It is now a question of establishing pigeon stations at certain places on the mountainous frontier, viz., at Franzenfeste for the Tyrol, at Karlsburg for Transylvania, at Serajevo for Bosnia, and at Mostar for Herzegovina, the object being to establish rapid communication by pigeons between the fortresses of the frontier and the passes of those mountainous regions.

In the experiments that the Austrians have made the following results have been attained:—

Vienna to Komorn, 144 kilometres, in 2½ hours. From Olmutz to Komorn, 206 kilometres, in 3 hours and 20 minutes. From Lemmaring to Vienna, 84 kilometres, in 1 hour and 20 minutes. The average rate of flight for these short journeys was therefore 1 kilometre per minute.[1]

Russia.

Russia appears to have been the first European country that adopted a military pigeon system.

In April, 1871, the Russian Government proposed, as already stated, to M. La Perre de Roo that he should undertake the organization of a pigeon system in Russian Poland. Although the offer was not accepted, several pigeon stations were shortly afterwards established, and a regular service of pigeon posts was organized. The first lofts were at St. Petersburg, Krasnoë-Solo, Moscow, Kieff, Varsovie, Warsaw, and Norvo-Georgewsk.

In parts of the Empire, however, the results were not satisfactory, and in 1883 some of the military lofts were abolished. A correspondent in St. Petersburg, who has made enquiries for me on the subject, writes, "The expense of the military lofts was very great, and for some years the results were almost *nil*, for several reasons—(1.) The native pigeons are no good for long journeys, and the imported ones die in great numbers, from the severity of the climate. (2.) The appearance of the Russian country and landscape is so uniform and monotonous, that the birds had no landmarks to guide them, and consequently were very often lost (all the villages in Russia are wonderfully alike, and the steppes also)."

These are some of the reasons assigned for the abolition of the pigeon stations. They are, however, not worth discussing, for it is known that homing pigeons can stand Arctic cold with impunity, and

[1] The Komorn birds have done some good work, but the Cracow loft has not been a success. Small lofts have been established at Olmutz, Riva, and Gardasel, by the private enterprise of Officers, who received birds from the Government on condition that the experiments were to be conducted at their own expense.

the monotonous aspect of the country is not a sufficient cause for the collapse of the pigeon communications.

The military authorities also assert that the organization was faulty, and left too much in the hands of amateurs.

"It is now intended to reorganize on a really efficient footing, and the affair has been placed in the hands of a Commission of Officers of the Engineers. As yet, however, nothing has actually been done, and the idea is to proceed tentatively at first. With this object, new stations are to be established at some of the western fortresses on the Vistula."

From Warsaw I learn that a regular pigeon service has been kept up for some years between several fortresses, and that there are lofts at Warsaw, Norvo-Georgewsk, Ivangorod, and Brest-Litovski, fortresses not very far apart. As general intercommunication is aimed at, there should be 500 birds at each of these stations.

The contemplated reorganization is confirmed in a telegram from a Russian correspondent of the "Times," which appeared in that paper in November last.

The sum annually voted for the maintenance of pigeon communications is said to have been 2,000*l*.

Lieutenant Mandry, of the Austrian Artillery, states in his paper, which has already been referred to, that experiments have recently been made to test the use of pigeons in tactical operations, where a turning force or detachment may be without communication with the main body. Such a case might readily occur through the nature of the country not admitting of the sufficiently rapid laying of a telegraph wire, or through the removal by the enemy of part of the wire which, under such circumstances, is usually dangerously exposed. In such a case the birds from the detachment would return to their loft, which should be the one nearest to the headquarters.[1] The messages would then be transmitted to the General Commanding by telegraph. These tactical experiments are said to have been carried out under General Stroukow during the last great manœuvres. "According to the report of the General, the experiments succeeded, and this method of communicating will very likely be introduced amongst the irregular cavalry for exploring service in front of the Army.

"It appears that in Afghanistan, and in their other far distant possessions where the telegraph can never be relied on to work with regularity, correspondence by pigeons may be the best means of securing the maintenance of communications."[2]

In some of the large towns, such as Kieff, Warsaw, snd Moscow, there are a few amateurs who breed and fly pigeons.

Italy.

In Italy there is an extensive military pigeon system which is now beginning to work satisfactorily.

[1] This suggests a question as to the length of time necessary for the establishment of a loft. From experiments that have been made, it is found that if suitable birds are available, they can be trained up to 50 miles within three weeks of the opening of the loft.

[2] "Bulletin de la Réunion des Officiers," 18th July, 1885.

The establishment of military lofts dates, I believe, from the beginning of 1872.

The stations on the north-western frontier are at Exilles, Fenestrella, and Vinadio. There are also military lofts at Alexandria, Genoa, and Bologna.

On the western coast Gaeta and Rome, the latter a large central station, are both furnished with pigeons.

Ancona on the eastern coast is an important central station; the loft is situated on high ground in the Villary Barrack. A subaltern Officer is in charge. The internal arrangements appear to be complete in all particulars, and a record is kept of everything that takes place amongst the pigeons.

According to the "Bulletin de la Réunion des Officiers," it is intended eventually "to increase the number of pigeons at Ancona to 2,000." This strength has, however, not yet been reached. In July, 1884, there were about 300 birds, of which 151 were old trained pigeons, and the remainder untried young ones.[1] The birds are divided into three sections, and are trained to Rome, to Genoa, and to Turin.

The north-western stations train their pigeons eastwards towards Ancona.

The lofts on the coast also train their birds out to sea, with a view to their employment as messengers from cruizers off the coast.

The "Bulletin de la Réunion des Officiers"[2] recently stated that "generally speaking, either on account of want of proper care, on account of climate, or on account of mismanagement, the breeding at Ancona has not been attended with success; neither have the results obtained in other respects been satisfactory. "For some years past the training experiments that have been made have not succeeded. This may be accounted for by the ill-chosen positions of intermediate stations, which may be either too far apart, or not in a straight line with the extreme points. The experiments are, nevertheless, still continued, and an improvement in the breed of bird employed, and in the instructions given, may be expected."

On 4th of June, 1884, experiments were carried out at Turin—on the occasion of the Zootechnical Exhibition—with Italian messenger pigeons carrying despatches. The birds were divided into groups.

The first group consisted of eight messengers for Ancona (315 miles distant), and started at 8.20 A.M. The next two groups were Bologna[3] birds, and started at 9 A.M. and 9.15 A.M. respectively. The fourth group was composed of six birds for Alexandria (50 miles distant). The fifth group was six birds for Exilles (35 miles distant); and the sixth and last lot were liberated at 10.30 A.M. for Fenestrella (32 miles distant).

The results of these experiments were published at the time in a Belgian newspaper[4] devoted to such matters. Of the eight Ancona

[1] These figures and other particulars relating to the Ancona loft, are taken from the newspaper "L'Ordine," of Ancona, of 4th June and 27th July, 1884.

[2] No. 29, of 18th July, 1885.

[3] Turin to Bologna is 190 miles.

[4] "L'Épervier, 6th July, 1884.

birds, two reached their home at 6.20 P.M. the same day, having taken ten hours to accomplish their journey of 315 miles, and four others arrived in the course of the next day.[1] It is not recorded whether the remaining two birds eventually turned up at their loft.

There are several private pigeon societies in Italy, but I am not able to give much information as to the work they have done.

The Modena Flying Club race from Ancona and from Rome.[2]

Spain.

Owing to the apparent liability of civil wars in S ain, the establishment of military pigeon stations would appear desirable in that country.

In 1876 the Minister of Marine decided to establish pigeon lofts at various coastguard stations. The idea was to employ the birds to communicate between the different stations, and also between the shore and naval cruizers which in war time would be employed to intercept the enemy's ships, and in peace time to stop smuggling. "Le Pigeon Messager" states that stations were established, and the experiments that were made were perfectly successful.

In 1879 the Minister of War ordered the erection of a pigeon loft at the Military School of Guadalajara.

Madrid, St. Sebastian, and Cadiz were subsequently furnished with pigeons.

The military pigeon service is under the orders of the Director of Engineers.[3]

Portugal.

The military pigeon system of Portugal dates from the year 1876. M. La Perre de Roo, after some correspondence with the Portuguese War Minister, had presented to the Government in the previous year several pairs of stock birds, which were kept as prisoners in a suitable pigeon loft at Lisbon, and became the progenitors of many of the working pigeons of the military lofts. New blood was subsequently introduced by the purchase of twenty pairs of birds from Antwerp and Liège. Under the able direction of Captain A. C. Bon de Sousa, who is an enthusiastic and experienced pigeon flyer, the various stations at which the lofts were to be established and the lines of flight were decided upon.

The original plan has not yet been fully carried out. There are now five lofts which have been in regular working order since 1881. These are Lisbon, Setubal, Tameos, Vedras Novas, and Elvas. To complete the system it is intended to establish a central loft at Oporto, and single section lofts at the frontier fortresses of Chaves,

[1] The result of the Turin-Ancona fly is taken from "L'Ordine," already referred to.

[2] In July, 1884, this club had a race from Ancona for young birds. Forty pigeons competed.

[3] "Telegraphia Militar," by Captain D. Carlos Banur, published in Barcelona, 1884, devotes one chapter to messenger pigeons.

Bragança, Almeida, Guarda, and Alcoutim. Lisbon is, of course, the headquarters, and the central station.

The Lisbon lofts are constructed on the most recent and approved systems, and being under the personal supervision of Colonel A. C. Bon de Sousa, now Director of Telegraphs and of Military Pigeons, are models of cleanliness and order.[1] They contain at the present time 400 birds which are trained to fly from Elvas (120 miles), from Vedras Novas (45 miles, almost in the same line), from Tameos (83 miles), and also from the north, and from Setubal (18 miles south).

At Setubal there are 100 birds trained to fly from Lisbon.

Tameos is a strategical point and entrenched camp of great importance, at the junction of the Zezare and Tagus, the hills forming strong positions covering Lisbon from an enemy's advance down the valley of either river. Here there are 150 birds trained from Elvas (60 miles), and from Lisbon (83 miles). Tameos is the School of Military Engineering.

At Vedras Novas (45 miles due east of Lisbon), where is the School of Artillery, there are 250 birds trained to Setubal and Lisbon.

At the important frontier fortress of Elvas (some 10 miles from the Spanish fortress of Badajos) there are 300 birds trained from Lisbon (120 miles), from Tameos (60 miles), and also from Chaves (210 miles).

As the whole length of Portugal is but 350 miles, there will be no difficulty, especially considering the central positions of these five pigeon stations, in securing communication with Lisbon from any part of the country.

The nature of the country and climate is not, however, favourable to pigeon flying. The country which the birds have to cross is intersected by several mountain ranges, the Sierra d'Estrella being in some places over 6,000 feet high, abounding in birds of prey, chiefly large vultures and hawks, and in winter covered with snow. Colonel Bon de Sousa states, in his book "Serviço dos Pombos-Correios," that the pigeons always fly down the passes along which they have been trained, and that very few are lost when in proper flying condition.

The climate presents considerable variations in the north and south provinces, the latter being very hot in summer, and consequently trying to the pigeons.

A velocity of 1,000 metres per minute has been attained, but the average rate of flight is 800 metres.

The introduction of military lofts has resulted, as is usually the case, in the general spread of pigeon flying throughout the country. I have been assured by a Portuguese gentleman that about eighteen months ago four pigeons belonging to Lisbon were liberated at Southampton, each with a message attached; two of the birds reached home, 900 miles from their starting point, but only one of them still carried its message.

Colonel Bon de Sousa has told me that on the 1st July, 1881, four pigeons belonging to a Pigeon Flying Society of Paris were liberated

[1] This information was kindly given me by a gentleman who visited the Lisbon lofts about twelve months ago.

at Lisbon, and that they all reached Paris on the 5th July, having flown nearly 900 miles.[1]

Denmark.

In Denmark there are no pigeons which are the property of the Government. There is, however, a pigeon club at Copenhagen, and others exist in the provinces. There is a monthly paper called "Brevduen," devoted entirely to the sport. Races are organized throughout the summer months, and the Danish War Office has recognized the possible utility of the pigeons by granting money prizes for some of the races.

It is not within the scope of this lecture to enter into particulars relating to the management of a loft of homing pigeons, or the method of training them. There are several English books devoted to this very interesting and important part of the subject.[2]

I will content myself with observing that the loft should be kept thoroughly clean, should not be damp, should be well lighted, and not overcrowded. Our English lofts are usually specially built. On the Continent the gable ends and attics of existing buildings are generally utilized. 200 birds is the maximum number that should be allowed in a single loft. If there are more, they must be homed in two or more lofts, which should be some distance apart.[3] The training consists in sending the birds in baskets (or paniers) away from home and liberating them, first at short distances, and then at longer ones until the goal is reached. Young birds in their first season, when about five months old, may be trained to fly home from a place 150 miles away. In their second season this distance should not be much increased, but in their third year they may be sent fully 400 miles.

Many men fail to achieve success with their pigeons and give up their birds in disgust. In a letter by "Voyageur," which appeared in "The Field" of December, 1872, the following observation occurs: "A man may have the best strain in the world, and if he does not understand the minutiæ of breeding, training, feeding, and general management, he may sit expecting his birds home till he gets such a crick in his neck that he vows he won't have anything more to do with the job. They simply don't come under those circumstances."

[1] The Americans are fond of flying "for distance record." They have accomplished journeys of over 900 miles. The greatest distance covered by a homing pigeon in America is reported in "The Homing Pigeon," New York, 26th Sept., 1885. The bird flew from Montgomery, Ala., to Fall River, Mass., the "air line" being 1,040 miles. The time taken was 20 days.

[2] "The Homing or Carrier Pigeon: Its History, General Management, and Method of Training," by W. B. Tegetmeier, F.Z.S. "The Homing Pigeon Fanciers' Guide," by J. W. Logan; price 2*s.* 6*d.*, from "The Stockkeeper" Office, 140, Fleet Street. "The Homing Pigeon," by J. L. Burgess, Latton, Cricklade, Wilts; price 1*s.* of the author.

[3] One hundred birds require a loft with a floor space of about 100 superficial square feet. When the pigeons are prisoners they require fully twice that amount of space.

It is therefore essential to exercise judgment in the selection of persons placed in charge of lofts, to make sure that they are by nature fitted for such duties, that they will take an interest in the breeding and work of the birds under their charge, and that they have been properly instructed by practical apprenticeship to their employment. There is no difficulty in doing this, and without these precautions failure at first is almost certain.[1]

To appreciate the perfection to which pigeon flying may be brought, a visit to Belgium is essential.

Belgium is the ancestral home of the European messenger pigeon. The Belgians were the pioneers of long-distance pigeon flying, which they originated more than sixty years ago.[2] Their devotion to the sport saved the *pigeon voyageur* from oblivion, when the introduction of steam and electricity threatened its universal extinction. "In that country pigeon races, or *concours*, still constitute the great national pastime, which is supported by munificent gifts from His Majesty the King of the Belgians and the Comte de Flandres, subsidies from the great cities, and subscriptions, amounting to many thousands of pounds annually by those interested in the pursuit."

There are nearly 2,000 flying clubs in the country, which own between them an enormous number of birds. The favourite direction for training is through Paris to the south-western extremity of France and even into Spain. In 1885 in a *concours* from Douai, 1,928 birds were liberated, while in the national *concours* of Bayonne (565 miles from Brussels), there were 1,155 competing birds.[3]

A large number of pigeons are also trained eastwards through Germany, and some westward to London. In 1884 the Belgians had races from Dover, London, and Sandhurst, in 1885 from Dover and from London: the average number of competitors was 500. In the Dover race of 1884, 1,000 birds started, of which some 300 were lost, owing to the thick weather in the Channel.

Reference has already been made to the important connection that exists between the work of private pigeon flying societies and that of Government pigeon establishments. It is therefore interesting to examine our own resources in trained pigeons, which have been developed by private enterprise, and which are capable of being placed at public disposal.

During the past few years very considerable progress has been made in this country in this respect, and at the present time a large

[1] It will have been observed that the first establishment of Government lofts has in many cases been a failure.

[2] The first Belgian fly of any importance was in 1818, when about 100 miles was accomplished. In 1820 a bird flew from Paris to Liège, about 200 miles. In 1823 the first race from London to Belgium is said to have taken place. At that time Liège was the chief centre of pigeon flying. The first Pigeon Society of Brussels was established about 1826.

[3] In the Belgian National Race from Lamothe in 1880 there were 3,637 competing birds, half of which arrived home on the day of liberation. Paris to Brussels, 170 miles, has been flown in two hours 20 minutes. There is a Belgian Society for the protection of pigeons. Rewards are offered for the conviction of persons who shoot or otherwise destroy pigeons. A price is set on the head of every bird of prey.

and still increasing number of persons take part in the sport of pigeon flying. The number of birds—old and young—put into training during the past season may be estimated at about 9,000. The great majority of these are trained through the medium of pigeon flying societies. The number of these societies in the United Kingdom is about forty—mostly in England. In the metropolis there are four: the chief of these is the London Columbarian Society, which races its old birds from Cherbourg, from Granville, from Rennes, from Napoléon Vendée, and from Bordeaux, and its young birds from Templecombe, Chard, and Exmouth. A conductor is invariably employed—as is the custom with all the more important societies—to take charge of the birds during their transit to their destinations, to attend to their wants and to liberate them, weather permitting, at the appointed time.

The result of the London Columbarian Society's races during the past season may be summarized as follows: 526 old birds were put into training and marked for the Continental races. In the Cherbourg race 226 pigeons were liberated, the velocity of the winner, which had flown 130 miles, being 1,437 yards per minute, and each of the first 41 birds attaining a velocity of over 1,000 yards. In the Granville race 126 birds were liberated; the velocities were somewhat higher than in the preceding case, while the average distance was nearly 200 miles. In the Rennes race 122 birds competed; but owing to bad weather during their flight, about half of them were lost; the eleven first prizes were nevertheless won with velocities of over 1,000 yards, with an average distance of 231 miles. The result of the race from Napoléon Vendée, 345 miles from London, and therefore 100 miles beyond the previous toss at Rennes, was, under the somewhat unusual attending circumstances, very remarkable. The birds left London on the 29th of June, for liberation on the 2nd July; but owing to bad weather, they were detained at Napoléon Vendée till the 7th, when a start was effected. They had, therefore, for eight clear days immediately preceding their flight of nearly 350 miles, been confined in a training panier. The first four birds, nevertheless, flew home at a rate of over 1,000 yards per minute. The Bordeaux race was not a success. Twelve birds started, but only two returned to England, and these were several days on the road. For the young bird races, 1,281 squeakers (young birds just out of the nest) were marked. The majority of these were, however, lost or taken off the road before they had done 100 miles. For the Templecombe race 240 birds competed (distance, 105 miles from London). For the Exmouth race, distance 160 miles, there were 53 competitors.

Of provincial societies, there are also several that do excellent work. Amongst these may be classed the "United Counties Flying Club," of which Mr. J. W. Logan is president; the "Manchester Flying Club;" the "Preston and Northern Counties Homing Society;" the "Southern Counties Flying Club," and a few others. These four clubs flew between them a total of over 1,000 old birds in their early races during last season, and a somewhat less number of young birds in their later races.

The "United Counties" is not only engaged in training and racing their birds, but offer prizes for open competition on payment of a fixed entrance fee. Pigeons taking part in the open races are divided into four groups, according to the districts in which their lofts are situated, so as to ensure some uniformity of distance. Their races are from Winchester, Ventnor, Cherbourg, Granville, Rennes, and La Rochelle with old birds, and shorter distances for young ones. Their last race from La Rochelle is worthy of record on account of the distance, over 450 miles, flown by some of the competing birds. Thirty-four birds were liberated at La Rochelle at 4.41 A.M. on July 18th, and the three first prizes were carried off by birds that reached their English homes before 9.15 A.M. on the following morning; but of the thirty-four starters, seventeen—or just one-half—were lost.

The Manchester Flying Club train their old birds as far as Vannes, 407 miles, and their young ones up to Swindon, 127 miles. They marked last season about 1,000 old birds and 600 young birds for racing. The Preston and Northern Counties Society fly from Rennes, 400 miles, with old birds: and from Chippenham, 157 miles, with young birds.

The birds of these two last-named clubs must always cross on their homeward journey the smoke-covered districts in which ironworks and cotton manufactories abound; but this does not appear to affect their velocities, which are often excellent.

The practical result of English fondness for the sport is that at the present moment there are in this country a considerable number of excellent and highly trained pigeons suitable for use as messengers in case of necessity. It is not easy to estimate with accuracy what that number is. Perhaps it is about 2,000, of which only 400 have flown over 200 miles, the remaining 1,600 having been trained from 100 to 200 miles.

Figures such as these, if even approximately correct, illustrate in a striking manner the proportion of loss which may attend the training of pigeons in England, for out of some 9,000 birds with which our English pigeon-flying campaigns of 1885 were begun, there are left but 2,000 reliable working birds. Of the remainder, 1,000 may be classed as insufficiently tested, and 6,000 as having been lost in training.[1]

In the limited time at my disposal, I cannot enter fully into the probable causes of so many losses. There can be little doubt, however, that as our experiences become extended and the quality of our birds improves, our percentage of losses will decrease.

Our variable climate, our liability to mists and fogs, will nevertheless always be responsible for more or less heavy losses in training, and we can hardly expect to do as good work with pigeons in this country as our Continental neighbours do abroad.

The chief point in connection with English pigeon flying to which I

[1] These statistics have been compiled with the assistance of returns kindly furnished by some of the leading societies. It must be borne in mind that a large number of birds that accomplished distances of over 200 miles were afterwards lost at 300 miles or perhaps more.

would draw attention is that we have in this country a widespread fondness for the sport which is capable of large and rapid development.[1]

As most foreign standard works on pigeon flying allude to the employment of pigeons by the Trinity House authorities, as the first official recognition in this country of the utility of these birds as messengers, and further as the attempt was not crowned with success, it is desirable that some allusion be made to it. The general idea was to obtain communication with light-ships by this means. The experiments were first commenced in 1876, and were continued without interruption up to March, 1885. The upper story of a disused lighthouse at Harwich was fitted up as a pigeon loft, and some suitable old birds were installed there as prisoners. The first year was spent in breeding from these, and in training the young ones to fly more especially across the sea. In the summer of 1877 the birds (then about twelve months old) were sent off in relays to the "Cork" and "Sunk" light-vessels, distant respectively about 5 and 12 miles from Harwich, where they were kept in roomy cages specially constructed for the purpose. Every time the Harwich sailing tender went to sea a fresh basket of birds was sent to the light-vessels, from which, when the weather was not too bad, a bird or two would be daily released. Many birds were from time to time lost, and the pigeon loft was reinforced by the addition of young birds (squeakers) purchased in Belgium.

After a trial of eight years[2] the attempt was abandoned, as the Board were convinced that for the purpose of the Trinity House pigeons were useless. They could only be depended upon to return home in fair weather. "In gales of wind or in snowy weather, which would be the only times when the light-vessels might be desirous of calling immediate succour from the shore for vessels in distress, the birds if sent up were invariably lost or refused to leave the ship." The pigeons therefore—100 in number—were sold by auction in London on the 3rd March, 1885. If the birds were intended for use in bad weather only, it is obvious the experiments were doomed to failure from the first.

It is not for me to venture an opinion on the desirability of establishing Government pigeon lofts in England.

I may, however, be permitted to indicate some of the considerations which bear upon the question, and which should not be lost sight of in discussing it. We enjoy some undoubted advantages through our insular position, and, as a rule, we are not given to underestimate them. These advantages do not, however, extend to the safety of our communications in case of war. In this respect we are in a far worse position than any other European nation. A Continental country could not be prevented from communicating with the rest of the world and be thrown entirely upon her own internal resources, except in the very improbable case of being at war with all surrounding neighbours. An invasion would affect her communications only to a limited extent.

With us the case is different. Our telegraphic communications with the external world might be severed without an invasion. Our submarine cables might be cut by an enemy who had never come within sight of our island.

I am not able to state what arrangements have been made by our naval authorities for the protection of the many cables[3] which radiate

[1] One of the chief obstacles to the development of pigeon racing in England is the heavy expense of training, that is, the high railway rates charged for live birds.

[2] These particulars were kindly furnished by the Trinity House authorities.

[3] The number of cables between the United Kingdom and places abroad is twenty-nine. Seven cables cross from Ireland to England and Scotland.

from these shores to all parts of the globe. It would obviously be a difficult task for our home or Channel fleets to watch and protect them all; while the great speed of war-ships of the present day would render hostile demonstrations of this nature by fast cruizers and other ships by no means difficult.

In such an emergency, pigeons afford a means of maintaining direct, cheap, and speedy communication with the Continent.

An organization of this nature existed half a century ago, when a regular interchange of correspondence took place between London and Cologne,[1] *viâ* Antwerp, and between London and Paris by means of messenger pigeons.[2]

A further use of pigeons applicable to our insular position, and on which the Italians appear to place some reliance, lies in their employment as messengers from an observation ship, or fast cruizer, told off to watch the movements of an enemy's fleet. By having a suitable number of birds on board, every movement of the enemy could, in moderate weather, be reported in the day time to a military station on shore. An illustration of the services that can be rendered by pigeons in such cases is afforded by Boyton's paddling cruize across the Channel in May, 1875. The South-Eastern Railway Company's steamer "Prince Ernest" accompanied the swimmer in his passage. Twelve trained pigeons belonging to Mr. T. G. Ledger, of Folkestone, were put on board. These birds were liberated at regular intervals, and carried reports to Folkestone, whence the messages were telegraphed to London. In this manner the London press was able to publish periodically on that day accounts of Boyton's progress.[3]

It has already been shown that, in case of actual invasion, pigeons probably afford the *only* means of preserving a fairly efficient system of corresponding.

If the view taken by a writer of a series of articles on "Volunteer Coast Defence" is to be accepted, it would appear that our coast frontier is in a "dangerously defenceless state."[4] He says: "We have many commercial ports, small harbours, open roadsteads, and inlets abounding on our coast which we have not the means of properly protecting, and for which we have no systematic scheme of coast defence."

In any case, in the presence of the large and formidable Continental navies, it is safest to regard the sea which surrounds us—and on which many build their convictions of insular safety—as a vast plain over which an enemy can easily move and approach us at any point and from any direction. We spend money freely on our forts and

[1] M. Lenzen is responsible for this statement.

[2] In 1836 there were three pigeon lofts at Dover, containing between them some 600 birds. They were all employed in this Continental service. Pigeons were also kept about this time at Folkestone for a similar purpose. The proprietors were stockbrokers and newspaper reporters.

[3] Pigeons were used in a similar manner in the late American International Yacht Race between the "Puritan" and the "Genesta."

[4] See "Army and Navy Gazette," 5th December, 1885, *et seq.*

coast defences, on the guns we put into them and on the men who garrison them, but we have no means of communicating with any of them in case they are invested.

In conclusion, I beg to be permitted to tender my best thanks to my many correspondents abroad, who, at considerable trouble to themselves, have kindly obtained for me information on the pigeon systems of the countries in which they are resident. Without their help, the descriptions of the foreign military systems would have been far more incomplete than they are.

The CHAIRMAN: I hope that this instructive and interesting lecture will be followed by information from other persons who have given their attention to this art; and if General Hassard, of the Royal Engineers, is here, who I believe has come at considerable trouble, and has great knowledge of this subject, I will ask him to open the discussion.

Major-General HASSARD, C.B.: I am here, Sir Beauchamp Walker, but I am afraid I have very little to say after the exhaustive manner in which Captain Allatt has brought the subject before you. I could say, of course, a great deal that he could also say about details, but that I think you do not want to hear. There is one thing which perhaps will amuse you, that these birds are not always employed for good purposes; sometimes they are employed for bad. About six weeks ago I heard they were used in South Africa—descendants of birds that I took there—to smuggle diamonds from Kimberley to Cape Colony. I quite agree with Captain Allatt in what he has said concerning the utility of the birds, but I do not think it necessary to say anything more.[1]

Mr. TEGETMEIER: Mr. Chairman, ladies, and gentlemen, I can only say I have heard with very great pleasure the very exhaustive and complete lecture of Captain Allatt. I may speak, perhaps, with some little authority on the matters, inasmuch as some ten years ago I myself brought the subject before the Engineering College at Chatham, and I have been very much interested in the subject of homing pigeons ever since my boyhood. With regard to the practicability of using these birds I am perfectly satisfied. In 1872 I got my friends at Brussels to send over 200 pigeons for a race from the Crystal Palace to Brussels. The pigeons were started at 12 o'clock (a very late hour of the day, considering the distance that they had to travel, and that they fly so much better earlier in the morning), and at the same time I went to the telegraph station, and telegraphed to my friend, a very well-known columbophile in Brussels, that the birds had started, but the pigeons reached Brussels first, and informed him that the telegram was coming. On that occasion I wrote a letter to the "Times," calling the attention of the military authorities to what I thought would be a great advantage of pigeon messages from armed cruizers watching an enemy's fleet, in case the submarine telegraph was broken. That letter was reprinted by my friend Mr. Gould, the eminent naturalist, in his work on "The Birds of Europe." To show that this was not an exceptional flight to Brussels, I may say it was repeated the next year, and two years afterwards it was repeated twice from the Alexandra Park. In all these cases the flights were accomplished with very great success. The return flights from Brussels to England were not as good, because our birds in England at that time had not been trained for long distances. I differ a little from my friend Captain Allatt, in believing that the utility of the birds will not be found in flying 300 or 400 miles, but in short stages of 40, 50, or 100 miles. In flying long distances of 300 or 400 miles, a very large number of birds are lost, whereas in the shorter distances under 100 miles practically very few of the birds are lost. I have always found in endeavouring to establish communication by pigeons, the great difficulty has been to get suitable men to take charge of them. Unless the man is what you may term a born pigeon

---

[1] In 1852—53 I employed pigeons to carry official messages between Guernsey and Alderney with success.

fancier, he is of very little use. An ordinary man, who may even be a lover of birds, or an obedient soldier, is not the man that will answer; you must have a man who is used to the birds, and really takes a very vital interest in them. That is a point about which I have found some difficulty. At the request of the Trinity House, I endeavoured to establish a pigeon service from the light-ships situated off Harwich, after the loss of a large German vessel on the sands some eight or ten years ago. The conditions were very severe on the birds, inasmuch as they had to be kept for a month on the light-ship, and the agitation of the vessel during the whole time when the weather was rough must have knocked about the birds in a rather dangerous manner. Still they saved some ships, and I believe some lives. Since then telegraphic communication has been established, and the pigeons have been discontinued. I may mention perhaps another case, which illustrates the value of these birds, under certain conditions, even over the electric telegraph. Originally the ships going out to India touched at Point de Galle, at the south of Ceylon, and communications were sent up by pigeons to Colombo, the seat of Government, and the news of the capture of Sebastopol was conveyed by pigeons to Colombo, and a salute was fired there celebrating the victory, solely on the authority of the intelligence brought by the pigeons. The editor and proprietor of the paper there told me of the anxiety with which the military men at Colombo came to his office in order to wait for the news brought 70 miles by the birds, where the electric telegraph was established and committed to the hands of the natives, and he gave up his pigeons, but after six months' experience he wrote to me and asked me to send him some more birds, because the pigeons were not only better, but would convey more intelligence, and at a greater rate than he could receive it by the electric telegraph as worked by the natives. These are a few illustrations of the practical use of pigeons, in corroboration of those mentioned by Captain Allatt. Captain Allatt said he thought it was quite impossible to make pigeons go anywhere except to one home. Now I am inclined to differ from him in this way. I think it is possible, that is to say, it is not out of the range of possibility, to make them follow a movable home. I recollect on one occasion being in one of the squares of London, and seeing a singularly formed handbarrow, drawn by a man and woman. It attracted my attention, as there were some pigeons in it; the man opened the barrow, and the pigeons flew out, and when he blew a little trumpet they returned. He sent them away again, and then moved the vehicle round the square down the adjacent streets; the trumpet was blown again, and back flew the birds. I do not know how far this idea could be practically worked out, but a correspondent in "The Field" some years since really drew out a plan by which he thought movable homes might be conveyed with armies, and pigeons might be trained to follow the army, and return to these small movable homes. I merely mention this. I do not think it so important as the fact of training them to fixed places, but still it might be possible. As to their utility in warfare, and the feasibility of their employment, the details which Captain Allatt has given of what took place at the Siege of Paris, with all of which I am perfectly acquainted, and know to be perfectly accurate, show how very feasible the plan is, and how exceedingly useful it may become.

Captain W. S. J. Hornby, R.N.: Sir Beauchamp Walker, my lords, ladies, and gentlemen, I think we must all be very much obliged to Captain Allatt for the very interesting lecture he has given us. Like my friend Mr. Tegetmeier, who I am delighted to see here this afternoon, I am one of those who have always from boyhood days taken a very great interest in pigeons, and when I have not been at sea I have always had birds. Before I went to sea I had a pigeon which did very good work. I flew it a distance of 25 miles: in these days of course it would be considered a very short distance, but in the year 1849 it was not so, and I then flew that little bird 25 miles. Another reason why I am glad that this lecture has been given here to-day is that now we have an opportunity of this subject being brought to the notice not only of the press but also of the military and naval authorities. I am quite aware that Mr. Tegetmeier years and years ago wrote on this subject, but the Government of this country, it appears to me, generally allows all new ideas, inventions, or discoveries to be conducted by private enterprise. As an illustration of the dawdling nature of the Government, I may say that when chain cables were first invented they were used—I won't say for ages—but certainly for years by merchant

ships before they were introduced into the Navy. It was the same thing with regard to iron tanks for holding water; water-casks were still used to a great extent when I went to sea, although the first private shipping firms had long discarded them. It was the same thing with reference to steel hawsers. The Admiralty are about the last to take up any useful invention of this sort. And so it seems to me with regard to pigeons. The great military Powers of Europe, as you have heard from the lecturer this afternoon, have all adopted the system of military pigeon-lofts, but it has been left in England to the private enterprise of individuals. Amongst those individuals I am glad to see Mr. Tegetmeier and Mr. John W. Logan are present. Mr. Tegetmeier was the first to introduce into this country the Antwerp or Belgian voyageur. I remember talking with him in 1870, before the siege of Paris, and he then told me just what *might* occur. When I was at Paris in 1884, I met the gentleman who has been mentioned by the lecturer, M. La Perre de Roo, and he told me that he was in Paris and had seen these high military authorities, and, as the lecturer said, they simply laughed at him when he told them he had pigeons which would be of some use to the country in case Paris was completely invested. Mr. Logan is the gentleman who instituted pigeon races for long-distance flying in this country, and he has flown further distances I believe than anyone—at all events until the London Columbarian Society came into the field. I had some splendid birds from Mr. Tegetmeier myself in 1870, but latterly, in consequence of living in London, I have not been able to do much in the way of joining Mr. Logan's club, which has its headquarters at Market Harboro', although I have taken great interest in, and have been present at much pigeon flying of all sorts. With regard to the distances flown by pigeons, perhaps I might say a word. Young birds five, six, seven, and eight weeks old will no doubt do 100 to 150 miles, but I do not think it is desirable that young birds should be taxed so far, and thus worked beyond their strength. I should not care myself to let a young bird do more at the outside than 100 miles during the first year. At the same time, with regard to the old birds, although it is a very grand thing to have birds that will do 400 or 500 miles, I think those are only extreme cases, and distances of 200 miles are to my mind quite sufficient to test the birds. For instance, from Brussels to London will be about 200 miles, and from Boulogne about 100 miles, and Cherbourg about 140 miles, and I do not think we want to get a single bird further than that—at least so far as military operations in this country are concerned. In the old times, and for years before telegraphs, when the stockbrokers used to depend upon pigeons for early information from foreign bourses, they had three or four relays. The pigeons used to come over the Channel to Dover or Folkestone, then from there to Redhill, from Redhill to Blackheath, and then into London. In this way they had three or four changes; but I fancy they did the distance as quickly as at present, and the time taken in changing the despatches from pigeon to pigeon was so very short, that they really gained in that way, as the birds, thoroughly knowing their road, were seldom lost. Mr. Tegetmeier touched upon pigeons being attached to floating objects. I can say in my own experience I have kept pigeons on board men-of-war on the Pacific Station and in the Mediterranean Fleet—the blue-jackets have often pigeons in the tops. But we never tried flying them; they never deserted their own ships, but they always knew one ship from the other.

Admiral Sir ERASMUS OMMANNEY: How many years would a pigeon work?

Captain HORNBY: Up to ten years. I should put the prime of the bird at from five to six years. With regard to some of the distances done, and the time in which they have done it, very much depends upon the state of the atmosphere, the clearness of the sky, and whether the birds have a fair wind or not; so that really the criterion of a bird flying at a certain speed is very delusive. I find that the United Counties Flying Club, of which Mr. John Logan is president, and his brother secretary, in 1884 did from Cherbourg, about 200 miles, at a speed of 796 yards a minute—but it was very stormy weather this side of Channel; from Granville, 267 miles, at an average of 830 yards a minute; from Rennes, 309 miles, at a speed of 806 yards a minute; from Nantes, 333 miles, at a speed of 795 yards a minute. Then they had a race from La Rochelle, 444 miles, on a very bad day, blowing hard; the first bird did not turn up for two days; but I believe they had another similar race from La Rochelle this (1885) year, and the winning bird arrived the

next morning. Those are very great distances for birds. On the Continent—especially in Belgium—they have great advantages, because the country is much flatter, the atmosphere is much clearer, and they have not the great disadvantage of having to come over the sea. Coming from Cherbourg or any of the towns of the South of France, our birds have to fly over 60 or 70 miles of water, where they can get no object to guide their sight at all, and if it is not very clear weather they have a very hard job to find their way—how they do manage goodness knows. Perhaps one of the most extraordinary races on record is one mentioned in a work written by Mr. Tegetmeier. The race was from Rome to various cities in Belgium; the distance being 900 miles. The first bird was ten days getting home. Of course for particular purposes in the way of military operations that would be useless, it was more to show what birds *will* do. In that case out of the 900 miles the birds had to fly, 500 miles was over ground which they had never been over before. In that case the birds would have to fly either over the mountains, or to go round by Nice, and so by Paris home—which they probably did. Out of the 200 pigeons liberated at Rome there were only 20 which arrived at their homes in Belgium. That shows what birds are capable of doing. Nothing will daunt them as long as they have strength and are not caught or shot. The most interesting point of late years with regard to pigeons has been the part that they played at the siege of Paris; but I think if the birds had been better birds and better trained—that is, if the Frenchmen had understood how to work birds like our English people do—they might have obtained better results. I will take any English working man, and he will know something about pigeons, but at that time (1870) in France nobody knew or cared much about them. Frenchmen, as a rule, do not care much about them, and there was only one pigeon club in Paris which at all went in for training and racing. Those birds were only trained in a northerly direction—and there were very few of them—and, as has been said by the lecturer, the authorities did not believe in them. The consequence was that Paris was eventually isolated and unable to hold communication with the armies in the provinces. I think military men will see that if the Parisians had had four or five hundred trained pigeons, there is no doubt they could have had easy and rapid communication with the Army of the Rhine, with the army that got shut up in Sedan, and with the army in Metz, and I leave it to military authorities to decide whether, if communication could have been opened up between Marshal MacMahon, Marshal Bazaine, and the General Commanding in Paris, there might not have been a different complexion put upon the war. With regard to a military pigeon system being taken up and adopted by the English Government, I think it is hardly possible at present to induce our Government to establish pigeon stations round this country. I do not advocate it; but I do think they might give subsidies to well-known and celebrated clubs, whereby prizes could be offered, and so the great expense of training would be in some degree met. One of the greatest difficulties of training pigeons is the expense of having suitable persons to take charge of them, and the heavy railway fares. I have done my own work for the last two years altogether by myself, and I have found it a great expense. By the formation of clubs a great deal of individual expense is avoided, but not to a sufficient extent, and working men who have a few birds are not able to find the money for entrance-fees and things of that sort. I think therefore that the Government might assist by giving prizes to some of the chief towns and the garrison towns, so that people might have an inducement to keep a few birds on hand, and then there would always be the certainty of having birds ready in case they were wanted.

Mr. Logan: I came this afternoon not to address any remarks to the gentlemen I see around me, but to try and gain a little information for myself; but as you have been kind enough to ask me to say a few words I will do so. I hope that Captain Allatt will pardon me for not agreeing with him in all that he says. I am very fond of the sport of pigeon-flying, and have been all my life. I may say I am a most ardent pigeon fancier, and, as a rule, I would vote with my party on pigeon-flying through thick and thin, but in this case I am afraid I cannot, because I prefer my country first. I should like to warn the military authorities of this country not to place too much reliance upon pigeons. On the Continent they have gloriously fine, clear weather day after day, month after month, the year round,

Here what have we? Nine months out of the twelve weather totally unfit for any bird or the best bird to fly in. I have been in town for the last fortnight, and during that fortnight if you had got together the best 300 birds in London (and there are some very good ones here) on very many days during that time, and had taken them 200 miles in a direction in which they had not been trained, you would perhaps not have seen one again for days or even a week, given a continuation of the same weather, for the weather has been totally unfit for pigeon-flying. I should have rather liked to have heard from Mr. Allatt some small details as to how he proposed to work the birds. I have read several letters on this subject, and have followed Mr. Tegetmeier and his movable loft; but God help old England, Mr. Tegetmeier, the day she relied upon your movable loft! I should like to say that, taking the ordinary weather round our coasts at any time of the year, with the exception of three months in the very finest weather, birds could not come into England if you took them 60 miles away. Therefore I say to those who are going to study the subject, let them bear in mind this one most important thing, and that is, that given the very best birds in the world, they cannot return home on a thick day when they cannot see, and I leave you to guess how many of those thick days we get in jolly old England. No, my friends, let us keep command of the sea round the coast, and do not let our telegraph-wires be cut, we shall not then want cruizers dodging about the Channel letting off birds here and there. Let us keep command of the sea, and then we shall not want any assistance from such unreliable messengers as homing pigeons.

Mr. TEGETMEIER: May I rise to correct a statement of my friend Mr. Logan? The proposal of movable lofts was not mine, and I merely threw it out as something that had been suggested. With regard to Mr. Logan's statement that the birds would not fly in winter, would you permit me to remind him that the birds sent out from Paris were 6 on November 2; 6 on November 4; 6, November 6; 32 on the 12th; 34 on the 18th; 24 on the 24th; and so on till the end of the month? Three pigeons were sent out on December 7; 18 on December 11; 15 on December 10, and continued during the very worst of the winter months, and of the 300 birds that were sent from Paris 73 returned with information. If only one pigeon out of 300 had come back, the intelligence would have been worth to the Parisians all the expense that was incurred by them.

Mr. F. A. KEY (President of the London Columbarian Society): I agree, Sir, with what has fallen from the gentlemen who have addressed this meeting, with the exception, perhaps, of the statement made by Captain Hornby, who has told us that from 100 to 150 *miles* is quite far enough to fly birds. Should unfortunately the necessity arise for us to have to avail ourselves of the services of pigeons for military purposes, and those pigeons whose lofts were in London, and happened to be liberated at a greater distance than 100 miles, say from off the south-west or westerly coast, the chances would be very few would see their homes again. I can only state that we have on occasion flown pigeons from Penzance, a distance of 270 miles, and from the Scilly Islands, a distance of 300 miles, to London. With reference to a subsidy from the Government, I may say that the London Columbarian Society does not fly for any money prizes, which it has been urged might give rise to gambling—we simply fly for honour, to see if we can get a first, second, third, or fourth class certificate, and then there is an end of it, so far as we are concerned. I am sure, therefore, that if any gentlemen present who have it in their power would recommend to the Government how highly prized a subsidy would be in a pecuniary sense to the societies all over the kingdom, I am sure it would be heartily appreciated. It has been urged that the objection to the use of pigeons by the military authorities is that in bad weather they will not always find their way home. That I do not take to be an objection, simply because, in the case for instance of pigeons taken in cruizers some distance from the coast, it does not follow that because they may not find their way to their own loft in London, they would not find their way to another loft elsewhere. As a rule, whenever a pigeon fancier finds a stray pigeon in his loft, he looks on its wings to see if there is a name on them, so that if he be an honest fancier, he may return it to the right owner. The pigeon will undoubtedly find its way to some cote or the other, and of course if pigeons were employed in time of war for intelligence purposes, every pigeon fancier would

be on the *qui vive.* There would be the more reason to examine every strange bird, to see if it was the bearer of information that would be of assistance to the authorities.

Captain HORNBY: May I say one word with regard to what has been said about birds not being able to return in foggy weather? Any experienced person will know that the weather is not always in a condition for the birds to fly in. I had a bird of my own last year, which I sent over from Folkestone to Boulogne, to be thrown up there, but when it arrived there the weather was so thick that it was decided not to liberate it. It rested in the basket till the next morning, and then, the weather being tolerably clear on the French side, the bird was thrown up. My friend in Folkestone wrote and told me the weather was so bad there that he did not think I should ever see the bird again. When the steamer came back to Folkestone in the afternoon, the weather was so thick on this side of the Channel that the gun had to be fired at Folkestone to show the steamer the position, and it was delayed a considerable time before it could get in. But in the meantime my bird had flown right over the fog (as we supposed), and long before the gun was fired at Folkestone my bird had arrived safely in his loft in London. This shows that the birds do try to get home thick or fine weather. This bird must have come right over the fog which was floating about in the Channel on our side, although not on the French. As I am probably the only Officer who has ever visited the inside of a foreign military pigeon loft, I will just mention that I had an introduction to the French military authorities at Paris, and being an Officer, was courteously allowed to see one of their military pigeon lofts in Paris. The pigeons were kept in the attics of the barracks, and were as fine a lot of birds as I have ever seen. In this particular loft they had 500 birds, which were trained to fly from the different frontier fortified towns. That loft is only one of a number. I thought I would mention this as a practical fact connected with the subject of the lecture.

General HASSARD, C.B.: When Captain Wharton (I think he is now the Hydrographer of the Admiralty) left Sheerness some few years ago, he had a surveying vessel called the "Fawn." He called upon me, knowing I knew a good deal about pigeons, and I think he called also on Mr. Tegetmeier. He said that some time ago, when they were surveying, they were very much delayed, sometimes for want of an angle, or other information, and he wanted to know if he could not take the birds on board, and let them go out in the boats, so that the information he wanted could be sent to him by the pigeons. Well, he was fitted out with baskets—we got them made at Sheerness—to go under the thwarts of the boat, in order that the pigeons might be taken out surveying. Sometimes the boats did not come back at night, and he was very anxious to know about them. The arrival of a pigeon might explain the reason. Singularly enough he came round the Cape when I was at Capetown, and I asked him about these pigeons. He said they flew fairly well, but as far as his object of getting information from the surveying boats was concerned they were a failure. This was not on account of insufficiency of intellect in the pigeons, but the fact was Jack had made them so tame on board, that they could not get them to fly away from the boats, and when he turned them out they would sit on his shoulders. They could not frighten them away to the ship. If the attempt is again made to use them in marine surveys, Jack must be ordered not to make them so tame, then I think, if the ship is not too far off, they might be used for this purpose. Captain Hornby stated that pigeons know their own ships. Admiral Luard told me that if any ships went away suddenly from harbour, and that the pigeons were absent, on the return of that ship they came back again to their own vessel. This shows that they even recognize individual ships.

Major GUNTER: I have had no practical experience in the training of pigeons, but I have for some time taken great interest in this question, and from what I have seen and read of their employment, I should like to support what Captain Allatt has said in regard to the great utility of pigeons for military purposes. I think they might be found especially useful in our Indian frontier warfare, and that pigeon centres might be established at stations along the frontier, so that in our many little wars, which take us into country where telegraph lines cannot well be laid down, trained pigeons might be taken with the force, and communication thus

rapidly established. When Sir Donald Stewart marched in 1880 from Kandahar towards Ghuznee and Kabul, to join hands with Sir Frederick Roberts, we were practically without communication of any kind until after reaching Ghuznee we were able to heliograph to the troops coming to meet us. The Kandahar force had been established in and about Kandahar for more than a year, and pigeons could have been trained during that period. When General Burrows moved on to intercept Ayoob Khan, the news of the latter's immediate approach could have been conveyed in about an hour to Kandahar from Maiwand. The weather in India is generally favourable to pigeon-flying. Pigeons were in ancient times a good deal used in the East as means of communication, and I have no doubt that the messenger pigeon would be found of especial use for military purposes in India as supplementary to other means of communication.

Mr. TEGETMEIER: Some five or six years ago I sent out through the India Office 50 pigeons to India, but I do not know whose hands they were put into, or what use was made of them. I sent them out at the request of the India Office.

Colonel BAYLIS: May I ask what time it takes for a pigeon to acquire a home that it will return to? I think it is a very interesting question.

Major GUNTER: Somebody asked as to the time of flight. I have a note here in regard to the Ceylon Pigeon Post mentioned by Mr. Tegetmeier. They took from one and a half to two hours flying from the Point de Galle to Colombo. During exceptionally heavy monsoon weather they took longer—but arrived. In fact this pigeon post was continuous and regular.

Captain ALLATT: Some allusion has been made to pigeons flying to homes that are movable. You will find in my lecture—although I did not read it because time was running short—an account of some experiments which have been made in Germany in that direction. I should, however, not like to place much reliance upon the services of birds that were intended to fly back to a home which had moved any considerable distance whilst they were on their journey. Their return I should say would be uncertain. I know that birds have been trained, not to "fetch and carry," but to fly from one place to another, and back again. It has been done in this way: the bird has been homed in one loft where after a time it has been fed as usual, but water has been withheld. It was then taken to another loft where only water was given it. It was then allowed to fly back to its old loft. When this process had been repeated a few times the bird would fly backwards and forwards between the two lofts for food or water. This can never be but an unreliable method of communicating, as food or water might be obtained in the country during a journey. With reference to the distance separating military lofts, I quite agree with what Mr. Tegetmeier has said, viz., that from 90 to 100 miles is sufficient.[1] The advantage of having military pigeon stations at such intervals would be, in the first place, young birds of four or five months old could be trained to fly 90 miles without a very large percentage of loss. If the pigeon lofts were further apart it would be necessary to employ older birds—birds of a couple of seasons. There is no advantage in training young birds over long distances. My own experience—which is not very great—and the experience of others whom I have consulted in the matter, leads me to believe that the best birds we fly in their second season are those which have been trained somewhere about 30 miles in their first year. If you train young birds 150 or 160 miles in their first season, I believe their constitution becomes affected, and they are not so good in their second year. I believe, as a general rule, that will be found to hold good. As to birds kept for stockbroking purposes, in 1836 there were 600 pigeons in three pigeon-lofts at Dover kept by stockbrokers for the purpose of communicating with Paris and Antwerp. I know the houses where the lofts were, and have frequently conversed with an old man who had charge of one of them. They had stations near Arras, at Boulogne, Dover, Canterbury, and two or three other intermediate stations up to London. In those days, you must remember, one great difficulty was to train the birds—because they had to be sent by coach. These birds were used by stockbrokers who received their information in London a long time before others who had not the advantage of pigeons, and in that way they were able to transact business much to their own

[1] This is the distance given by M. Lenzen.

advantage. With reference to the long-distance races alluded to, I think it will be found that the distance from Rome to Brussels is a good deal less than 900 miles.[1] I believe the longest-distance record we have, has been flown in America, where 1,040 miles has been done by one pigeon—and the Americans have several birds that have done over 900 miles. There is a newspaper called the "Homing Pigeon," published in America, which I occasionally get, and from which I get these particulars. Mr. Logan said he should hardly consider birds reliable to fly 100 miles on a bad day in a direction in which they had not been trained. The simple answer is they should not be sent in a direction in which they had not been trained. I should train them first, and then only send them in the direction in which they had been trained. Of course if the weather is very bad, birds are bound to be lost, but some always come home, even on very bad days. As to the time it takes to home a pigeon properly, you must get him as a young bird—about four or five weeks old. You keep him in his loft three or four days, and then let him out. The best time is in the evening. After he is fed he is not inclined to fly; he goes outside his loft, looks about, and comes in again. The next day you let him out, and he is sure to come back again. You never can rely upon homing old birds which have been trained in other countries or on other lines of flight; you never can depend upon homing them in any other place but the one in which they first saw the outside of their loft. I have now and again succeeded in homing old-trained birds. I have a bird which flew from Tours to Brussels—300 miles. He is homed at Sandhurst, and he flies out with the other birds, but that is exceptional. As a rule with trained birds, directly they are let out—even if they have been kept as prisoners two, three, or four years—the first time they are let out, away they go looking for their old home. As an instance, I may mention a case that occurred a few weeks ago. A gentleman had kept a bird confined from five to six years at Redhill, and then thinking it was pretty safe, he let him out. The bird went straight away, and he saw it no more. With reference to the length of time that pigeons will sustain their flight, that of course depends chiefly upon the weather. If the weather be favourable, birds will fly 250 miles without alighting. Over that distance it is generally found that the bird has alighted. This may be detected by looking at his feet and the end of his tail-feathers, which will generally indicate whether the bird has landed anywhere between the time of departure and the time of arrival.

The CHAIRMAN: Ladies and gentlemen, I think a very warm vote of thanks is due to Captain Allatt, not only for having furnished us with an extremely valuable lecture on this subject—which I am inclined to look upon as one of considerable importance—but also as having attracted to our theatre gentlemen who have furnished us with still further information. I have always thought that one of the great advantages of the lectures in this Institution is that the discussions attract gentlemen of all classes of life and of varying opinions, who afford us a very excellent addition to the lectures to which we listen. I must confess to knowing nothing about pigeons, excepting that as an article of food I look upon a pigeon as the meanest food that exists. I perfectly remember from my earliest youth I have always been told that a person who ate a pigeon daily for a month would die at the end of it. I do not know whether that meant a month of 28, 30, or 31 days, but such was always the saying, and, excepting in pie—and there the pigeon has been almost ousted by the young rook—I really do not know in what shape pigeon is fit to be eaten, excepting as a cutlet, and then he is very good: the breast just taken off and cooked as a cutlet eats very well. But I must say when I dine out, and find the only game to be had is pigeon, I make a very hearty dinner beforehand, because I do not much care about the end of the feast. I beg that you will allow me to tender, in the name of the present assembly, our very warm thanks to Captain Allatt, and also to those gentlemen who have so kindly favoured us with remarks.

[1] The distance in a straight line is 720 miles.

Friday, February 5, 1886.

MAJOR-GENERAL SIR ANDREW CLARKE, G.C.M.G., C.B., C.I.E., Inspector-General of Fortifications, &c., in the Chair.

ON SUBMARINE BOATS.

By THORSTEN NORDENFELT, Esq.

WHEN the Council of this Institution did me the honour to call upon me to read this lecture, I felt considerable hesitation how to deal with the subject, as it covers too large a ground for one single lecture. I, however, came to the conclusion that I should best meet the wishes of the members by stating what has been done, and what is being done in this direction, and by giving my views upon what can and what cannot be done by submarine boats in practical warfare; and not to encumber the lecture with too many technical and scientific details, as these would form sufficient material for a separate lecture, which might perhaps more properly belong to the Naval Architects or other scientific institutions.

First, I beg to be allowed to say that I cannot admit, as I have heard stated, that there is anything especially cruel or horrible in the idea of a submarine boat.

War altogether is cruel and horrible, and causes an enormons amount of pain and suffering, but any invention which may tend to shorten a war, or to protect commerce and private property during war, will really diminish this suffering on the whole.

It has been said that there is something especially cruel in the fact that a submarine boat advances in secrecy, and without giving the opponents any chance of firing at it or of protecting themselves against it, but the whole tendency of war has moved in this direction, ever since the days of old, when Hector and Achilles advanced in front of their respective followers, and spent half-an-hour in abusing their adversary's parents and ancestors before they commenced to fight.

What can be more cruel than the leaden bullet which kills at the distance of a mile when you cannot see either the rifle or the man who fires the bullet; or the shell from a 100-ton gun, which may

cause the destruction of a large vessel six miles from shore if it strikes a vital part?

A fish torpedo is a secret missile, and hitherto every naval architect has done his utmost to render it more effective by increasing the speed of the surface torpedo-boats, and thereby make the attack more sudden and unexpected. If I have gone a step further by carrying the torpedo under water up to the point where it can be most effectually discharged, I have made the attack still more sudden and unexpected, but I have at the same time increased the chances of safety for the crew of the torpedo carrier, who in a surface boat are as much exposed as was the light brigade which charged the Balaclava batteries.

The same secrecy or suddenness of attack is permitted ashore; the whole object of strategy is to keep the enemy ignorant or to mislead him as to the movements of an army until the General can deliver a sudden attack by overwhelming forces, and an ambush is nothing but the development of this idea. Sir Andrew Clarke, and other leaders of modern engineering, are now averse to the heavy granite structures which offered a long range target for the enemy's ship, and do their utmost to assimilate the appearance of the batteries to the surrounding country by covering the earth with turf and shrubs; the latest development of which idea is the revival in another shape of Moncrieff mountings by the present Inspector-General of Fortifications in the disappearing gun platform which can be laid against the enemy's ship before the heavy gun suddenly appears out of a peaceful looking ploughed field, discharges its deadly projectile, and again disappears through its trap-door, after having shown itself for a few seconds only.

The principal *raison d'être* of a submarine boat is the suddenness of its attack, and if the attack by torpedoes fired from a submarine boat is more effective than that fired from a surface boat, while the crew is less exposed in the submarine boat, it should find its place amongst the armaments of nations.

The submarine boat is and must always remain essentially a means of defence, and when ports can be defended by submarine boats against bombardments and blockades, even if their action were cruel and horrible, the enemy can best avoid any suffering from their action by refraining from attacking the ports of my country, and then my object would be gained.

The idea of submarine boats is very old. The first record I have found of such a boat is the one which was built by David Bushnell during the American War of Independence.

As early as 1776 this boat was used in an attempt to blow up the English man-of-war the "Eagle;" it, however, failed to do so, and there was a strong suspicion, when the man who undertook the task returned to shore the next morning to claim his reward, that he had never seriously tried, but had passed his night comfortably floating on the water.

Washington, in a letter to Jefferson, in 1785, wrote that it was difficult to find men to undertake the risk of making an attack with

this entirely novel invention in consequence of the difficulty of driving and steering it under water, and the uncertainty of attaining its object.

It was not a comfortable boat, its appearance was that of two turtle-backs screwed together, its crew consisted of only one man, who had air enough for thirty minutes, during which time he had to work by hand the screw which propelled the boat, to pump in and out water by hand for descending to desired depths, and to let go 200 lbs. of ballast for rapidly rising to the surface.

The explosive mine contained 150 lbs. of powder, and was to be screwed into the bottom of the enemy's wooden vessel, after which the charge was exploded by clockwork started by the operator when he retired after having fixed his mine.

This of course sounds very crude, still it contained the germs of nearly all the subsequent unsuccessful attempts to make efficient submarine boats.

Next came Robert Fulton, who tried a submarine boat, also propelled by hand, at Brest, in France, where he remained under water for one hour. As the French Government did not adopt his invention, Fulton went in 1784 to England, where Pitt showed considerable interest in his invention, and some very costly experiments were carried out with his submarine boat as well as with his surface torpedoes, which, however, did not lead to any results.

Fulton then returned to his native land, and the United States Government paid for serious attempts to develop his inventions, without success, however, as far as the submarine boat was concerned.

In 1821, an Englishman, Johnson, built a submarine boat on the Thames, which turned out a failure altogether. I have not been able to find any details of the construction of this boat.

Nothing more was heard of submarine boats until 1851, when a Bavarian, by name of Bauer, constructed a submarine boat for the Holsteiners to use against the Danish war-ships which blockaded Kiel. It was not, however, completed in time, and did not give satisfaction when ready. It was propelled by hand, with pumps for changing the specific gravity of the boat, and a special apparatus with watertight gloves, for fixing under the vessel a mine which was to be fired by electricity. At the final trial the boat sank right enough, but could not be raised.

About the same time a Frenchman called Alexandré had some trials in New York Harbour with a submarine boat, but it does not seem to have offered any new feature.

At the time of the Crimean War, the Russians, according to subsequent reports in the English press, used a sort of submarine mine which could be moved a certain distance, but which could hardly be called a boat. A full description was given of this in the "Illustrated London News" for the 23rd June, 1855.

Two explosions were said to have taken place under H.M.S. "Merlin," off Cronstadt, the shocks of which caused considerable alarm on board, without, however, doing much damage. This

movable mine was probably some modification of Dr. Payerne's movable diving bell which was tried in 1847 in Paris and Cherbourg, and which was described in "La Presse," in 1847.

During the War of Secession in the United States, the attention of both sides was drawn to submarine boats. The Northern Government, anxious to destroy the Southern ironclad "Merrimac," are stated to have agreed to pay a Frenchman 10,000*l.* for his invention of a submarine boat, with a further sum of 5,000*l.* for each successful attack. The first-named sum seems to have been paid, but the boat was never successfully built.

The Confederate authorities carried the point further, and actually sank one or two Northern vessels by means of such boats. The first boat, made of thin iron plates, was 35 feet long, 3 feet beam, and 5 feet deep; she was propelled by hand by eight men, who worked a longitudinal shaft, which, by gearing, gave a considerable number of revolutions to her screw. Her greatest speed was 4 knots in smooth water; the air-space in her was said to be sufficient for the eight men and the captain for two hours. Two side rudders were used for sinking and raising the boat when in motion, and its depth was supposed to be regulated by the incline given to these rudders; when not moving, the boat was sunk and raised by taking in and pumping out water. The boat was meant to tow a mine which would explode on contact with the enemy's vessel; but when this boat sank the Federal vessel "Housatonic," in February, 1864, she used a spar torpedo; the great danger of this was proved by her going down, with her crew of nine men, together with the ship she destroyed. The Federal flagship "Harvest Moon," Admiral Dahlgren, was also sunk by a mine; but though the Continental press at the time stated that this mine was carried by a submarine boat, other reports say that it was a fixed ground mine.

At the Paris Exhibition, 1867, another submarine boat was shown, designed by Admiral Bourgois and Mr. Brune. She was 26 feet long and 9 feet deep; her screw, worked by four men, was said to give her 4 knots speed; she also descended and ascended by means of water being taken in and pumped out. Secret experiments are said to have been made with this boat by the French Government.

The Russian Government has for years spent large sums of money upon the perfection of submarine boats. In 1868 a boat, built of the so-called "Alexandrofsky" type, was run on the Neva, off Mr. Winans' railway works; she was towed by a steam launch and descended successfully several times, but did not seem to satisfy the Russian naval authorities.

About five years ago another submarine boat, made on what is called the "Bjevalsky" system, was tried in St. Petersburg. I have not seen any other details given of her than that she is 20 feet long, and is propelled by a screw worked by four men; that she descends and ascends by increasing and diminishing her water ballast; she is said to be held in horizontal position by shifting the water ballast longitudinally fore and aft; air is supplied through chemical means to keep her crew under water up to nine hours. She is said to have

often descended to a depth of 15 feet, and her speed is 3 knots. A considerable number of these "Bjevalskys" are reported to have been built for coast defence in Russia.

The "Engineering," of 20th November, contains a very full description of the "Goubet" system of submarine boat, a large number of which are said to have been ordered by the Russian Government. This description seems very like what in Russia is called the "Bjevalsky" system, though the "Goubet" boat requires only two men. The "Goubet" boat descends and ascends by taking in and pumping out water, in addition to which a heavy weight can be dropped if it is necessary to rise to the surface more quickly than by pumping out water. The mine contains 110 lbs. of dynamite, and when the submarine boat has reached a position directly underneath the enemy's vessel the mine is cast off and rises through its floatability, when it is meant to attach itself to the bottom of the vessel by means of a ring of spikes; this done, the submarine boat retires to a safe distance and the mine is fired electrically through a connecting wire.

It is intended to apply electrical motive power to this boat by accumulators; but the constructors do not seem to place much faith in this, as they have applied oars to be used if or when the electrical motors fail.

Mr. Garrett designed a submarine boat some ten years ago, and one was built by Messrs. Cochrane, of Liverpool. This boat was 45 feet long, of the shape of two cones, with a central cylindrical portion. It descended by means of pistons which varied the displacement of the boat by being drawn in and pushed out, as well as by central rudders which steered it up and down like the Confederate boat. Compressed air as well as chemical compounds were carried to give air to the crew. This boat was never applied to war purposes, but after a number of experiments it was lost off the Welsh coast, and I have had much advantage of the negative experience gained during those experiments in avoiding the faults which made that boat unsuccessful.

The idea seems throughout to have been admitted that submarine boats, if successful, would become most valuable and comparatively inexpensive weapons for port defence; but none of the boats so far have given satisfaction, and I now beg to give my views as to the reason of their failure.

1. They were always built too small and too weak. The longest of previous submarine boats was 45 feet, or about half as long as my boats. Their small dimensions and weak plates made them useless in bad weather and dangerous for submersion, especially if touching the bottom, or if coming in contact with any vessel. The small air space available in such small boats also forced the crew to use chemical means to obtain pure air.

2. They have never been made for firing a fish torpedo, consequently they have had to endeavour to fix a mine to the bottom of a vessel, which I consider impracticable, considering the risk of contact with the vessel, which, especially if pitching or moving, might easily destroy the boat. This also necessitates a complication of clockwork

or electrical connections to enable the boat to get away to avoid the fatal risk of being destroyed by the attacked vessel, as was the case with the boat which sank the "Housatonic."

3. In all the early boats the mines were charged with only black powder, the effect of which was less destructive than that of the gun-cotton or dynamite in the fish torpedoes; and the effect of the explosion against a wooden ship was nothing like as serious as against the thin bottom plates of an ironclad.

4. All the boats hitherto in use have been propelled by hand power. This gave too much hard work to the crew, who could not take the boat any distance on the surface previous to the actual attack, and made it quite impossible to face any rough weather.

In my boats, the use of steam diminishes the number of men, and they have so little to do when below the surface, that the temperature, which is anyhow lower than in modern stokeholes, is no detriment; the stokers, for instance, in my boats, have nothing at all to do when the boats are submerged. My boats can go 150 miles and upwards, previous to the attack, without re-coaling.

5. All previous boats had most unreliable means of descending and ascending. The descent by steering downwards in the American boats, twenty years ago, was quite as dangerous as the attempts before and after that time to lower and raise the boats, and to keep them steady at any desired depth, by means of increasing and decreasing the weight of the boats by more or less water-ballast, or by altering their displacement.

None of these boats used the principle which I have applied to pull the boat down by mechanical means, while relying upon its always retained buoyancy for rising; so that if the mechanical apparatus fail, the boat rises at once to the surface. Nor did they have the tendency to steadiness given by the two forces of constant pulling down, by my horizontal screws, acting all the time, whether still or moving, against the pulling upwards caused by the buoyancy.

I should consider it most dangerous to rely upon a detachable weight in case of emergency, as the apparatus for detaching it would be always liable to fail.

I cannot imagine how the longitudinal instability of a submerged boat can possibly have been satisfactorily controlled by any of the means applied to the previous boats; and even if the appliances used had been more perfect, they would probably not have been sufficiently effective for such very light boats without much inertia. Even Goubet's system of moving water or weights fore and aft inside the boat must act much more slowly, and cause more diving and oscillation than my rudders, which always remain in the horizontal, and thus control the slightest tendency of the boat to get out of the longitudinally horizontal position.

I consider it absolutely essential to keep the boat horizontal when moving, as any inclination downwards, with the impetus of a heavy boat, would almost to a certainty carry the boat below its safe depth before it could be effectually counteracted by shifting weights.

These are, as far as I have been able to ascertain, the more

important steps in the direction of submarine boats, which had been taken previous to my attention being drawn to the subject, five years ago.

The position, then, as regards torpedo warfare, seemed to me to be as follows:

The submarine mines, placed at the bottom or floating anchored, had been adopted generally; but they were acknowledged not to fully satisfy the requirements for port defence, because they were immovable, and were exposed to be picked up by the enemy.

The towed torpedoes of the Harvey class had not given satisfaction, and the spar torpedoes could only be used under very exceptional circumstances. The Whitehead and Schwarzkopf fish torpedoes were then the only ones which gave any hope of usefulness by future development.

Apart from the faults and difficulties in the construction and management of the fish torpedo itself, there seemed to be an almost insuperable difficulty in carrying it, with any degree of certainty, up to the short distance at which it could be considered infallibly effective.

The fish torpedo is practically a projectile, and the torpedo boat may be called the gun which fires it; but the great expense in time of peace, added to the certainty of losing a number of these boats in war, made this means of discharging torpedoes exceedingly costly and unreliable.

It seemed to me, therefore, of great importance to construct a means of carrying, with greater safety, the fish torpedoes up to such a short distance from the vessel to be attacked, as that the torpedo could not fail to hit.

The surface torpedo-boats at that date were met by machine-guns which made their attack in daytime almost impossible; and the improvements in the direction of greater speed and thicker protection of their vital parts, have been met by greater power and longer range of the quick-firing machine-guns, while their larger dimensions offer a target more easily hit. Thus, to-day, the surface torpedo-boats really do not offer much greater certainty of reaching striking distance than they did five years ago.

It seemed to me that a much greater chance would be given for carrying the Whitehead torpedo within striking distance, if, instead of trying to rush the distance by many boats all the time exposed to the destructive fire from machine-guns, I could carry the torpedo secretly up to this distance without the probability of being seen at all, and without any probability of being struck by the enemy's shot, even if seen.

This led me to take up—with a view to make it a practical success—the question of submarine boats; and, instead of publishing any accounts of my proposals, I thought it best to build at once such a submarine boat as could not be suspected of being only an experimental boat, but one really useful in war.

I propose to describe the boat itself, and then to give my views about its utility and manœuvring.

The first boat I built at Stockholm, and which I had the honour to run at the experiments in Sweden last September, in the presence of delegates from most of the leading Governments, is shown on the drawing No. 1. The following are its principal dimensions and details:

Length 64 feet, beam 9 feet, but over sponsons 12 feet, draft 11 feet; displacement 60 tons; speed, on measured mile, 9 knots; distance travelled without re-coaling, 150 miles; depth to which it can safely descend, about 50 feet.

Engines, surface condensing compound type, with 2 cylinders and cranks at 90°, and, at pressure of 100 lbs. to square inch, will indicate 100 horse-power. Boiler of ordinary marine return tube type, having 1 furnace, and about 200 square feet of heating surface.

Two hot water cisterns, rhomboidal in body, with spherical ends.

The boilers and cisterns contain about 8 tons of water. Both boilers and cisterns are made for a working pressure of 150 lbs. to square inch.

One fish torpedo, 14 feet, is carried outside on the bow, and discharged mechanically.

The sinking apparatus consists of 2 horizontal propellers driven by a 6 horse-power double cylinder engine. These propellers are placed in sponsons on each side of the boat.

One cold water tank in centre of boat, holding about 4 tons of water for regulating buoyancy. This tank is used as coal bunker when doing long surface runs. Crew, three men.

For longer distances, out of sight of the enemy, the boat runs on the surface, with the cupola and about 3 feet of its turtle back out of water, but by forced draught, blowing out its smoke under the surface.

When the boat arrives within such distance of the enemy that it might be discovered, it descends into the water so far that the cupola alone appears above water; this is done by taking in water into the cold water tanks sufficient to reduce the floatability to what my horizontal screws are capable of overpowering; she runs thus "awash" until she arrives so near that even the small cupola might be discovered, then she descends altogether below the surface and advances up to striking distance entirely submerged, unless she requires to show the cupola above the surface once or twice for a few seconds to adjust her direction.

The above-named reduced floatability is never done away with, but the descent from the "awash" position is effected by starting the horizontal screws, thus overcoming mechanically the buoyancy of the boat, which is pulled down to a less or greater depth, depending upon the speed given to the horizontal screws.

As the density of water does not alter at varying depths, I can always count upon the exact amount of buoyancy being available for raising the boat to the surface whenever I stop the horizontal screws, or for lifting the boat nearer to the surface when I reduce the speed of the engines driving them. Thus, if any failure of these engines or propellers were to take place the boat would at once rise to the surface.

n
o

d

y
d

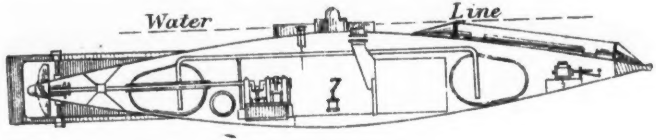
of
er

on
of
e.
it
la
he
ri-
"
is-
es
ow
ust

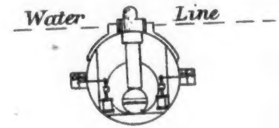
out
the
the
oon

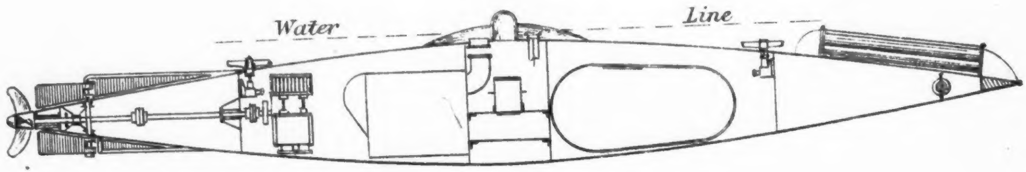
can
ble
ntal
the
ese
rise

NORDENFELT SUBMARINE BOAT.



Nº 1. 64 FT. BOAT





Nº 2. 100 FT. BOAT.

Harrison & Sons Lith. St Martins Lane, W.C.

In addition to my controlling the depth by varying the speed of the horizontal propellers, I have applied an apparatus for definitely regulating the depth at which I mean to move; this consists of a valve which controls the steam supply to the small engine; this valve being held open by a weight adjustable on a lever, the piston of the valve is also in direct communication with the sea, in such a manner that when I reach a depth at which the pressure in the sea is more than the pressure of the weight, the valve closes, the engines stop, and the buoyancy raises the boat until the outside pressure diminishes, when the weight again opens the valve. By this means I exactly regulate the depth at which I desire to move.

When descending below the surface I carry altogether about eight tons of water, subject to the full pressure of steam, so that in case of more leakage than I can pump out of the boat by my steam pumps, I can at once counteract such leakage and rise to the surface by blowing out water. This must be much more reliable than to detach weights.

On the surface I drive the boat by working the boiler in the usual manner, and I keep up the temperature of the water in the cisterns to a degree corresponding to a steam pressure of 150 lbs. When I wish to descend, I close the ashpit and fire-door, then I close up the funnel inside boat and start the horizontal propellers.

At this moment I thus have, as propelling power under water, the steam which will be given off by the heated water (about eight tons), and this has been found sufficient for a distance run of 14 knots; or more than is required for an attack in war. On that occasion we had still over 20 lbs. pressure in the boiler when the boat was opened up.

The boat is laterally very stiff, as I carry some six tons of lead in the bilge.

Longitudinally the boat is balanced before starting by the arrangements of weights, and this can be adjusted by having more or less water in the two cisterns fore and aft.

When descending, the boat is perfectly horizontal, and is invariably kept so when moving under water, by means of the bow rudders operated by a plumb weight. These bow rudders have been found to act so perfectly, that there is actually no appreciable change from the horizontal position.

Although the centre of gravity is well under the metacentre, the boat is so sensitive longitudinally, that the bow rudders correct instantly any tendency to deviation from the horizontal position.

Since the Swedish trials in September last, I have had time to adapt to that boat all the more important improvements which have been suggested by the experience gained, so that this boat is now a thoroughly efficient instrument for practical use.

Three men are sufficient crew for the boat, and I have proved that these men do not require any other air for sustenance in comfort than what the air space in the boat itself contains.

The dimensions of this first boat, as well as its speed and proportions, were settled especially for defence of coasts where there is an archipelago, as in Sweden, the west of Scotland, &c., and for the defence of ports with long estuaries, for instance, London, Liver-

pool, &c., and I am still convinced that where handiness and small draught of water are important factors, these proportions cannot be much improved upon.

For the defence of open coasts and for operations where it may be necessary to keep the sea for days together, without being able to seek the shelter of inlets or the mouths of rivers, other and larger proportions will, of course, be desirable, and I am now constructing boats on such larger lines, feeling certain that both the smaller and larger types will become necessary.

The lines of my boats are drawn specially suitable for giving least resistance when the boats are submerged, consequently they are not so good when part of the boat is above water. The surface speed of my small boat being 9 knots, she is capable of even greater speed when submerged, thus she can always, whether on the surface or below, do 4 to 5 knots against a 4-mile current.

The question of what speed below water is most desirable, must be found out by experience, and must depend upon the room and depth of water available, and upon how far greater speed, when submerged, may tend to detract from the secrecy of attack, and upon other questions which can only be determined by lengthened practice by intelligent Officers, when fully trained to its use.

The following are the details of my larger boats (Drawing No. 2) :—

Length 100 feet, beam 12 feet, displacement 160 tons, speed on measured mile 12 knots, distance travelled without re-coaling 900 miles, depth to which it can safely descend about 50 feet.

Engines are of surface condensing compound type, with two cylinders, and cranks at 90°, and at a pressure of 100 lbs. of steam will indicate 250 horse-power.

Boiler is of the ordinary marine return tube type, having two furnaces; about 750 square feet of heating surface.

Hot water cistern is rhomboidal in body with spherical ends.

Both boiler and cistern are made for a working pressure of 150 lbs. per square inch.

Two fish torpedoes, 14 feet long, are carried outside on the bow, which are discharged mechanically.

Sinking apparatus consists of two vertical propellers driven by two engines, which each indicate 6 horse-power.

Two main cold water cisterns placed at each end, and containing 15 tons of water each, also one in centre of boat for regulating buoyancy, containing 7 tons, coal bunkers on the side of boiler: 8 tons of coal are carried at the side of hot water cistern and in middle of boat.

Crew.—Three men in a watch; two watches carried.

With coal in the bunkers only, this boat can keep the sea for five days or more, and thus would be especially suitable for cruizing off the south coast of England, ready to defend any port in the channel which might be threatened, or for action as despatch boat in passing unseen an enemy's line of vessels.

Both the large and small boats are, of course, provided with compasses, pressure gauges, and all instruments required for gauging the

depth under the surface, the balancing of the boat, the purity of the air, and for all other purposes connected with submarine warfare.

The three main points in my system of submarine boat to which I particularly wish to draw attention, are :—

1st. That by using water as the means of storing up energy, I am in possession of a reservoir which can never get out of order and which can be replaced at any hour in any part of the world, and without any extraneous assistance from shore or other ships. Whereas if electricity were used, delicate and special apparatus would have to be employed as reservoirs of energy, such as accumulators or batteries, which if they should require repair or replacement would render the boat completely *hors de combat*, unless she were within reach of some electrical depôt. Also the durability of the cistern containing the water is immensely greater than of electrical apparatuses, which—should a run of any distance be required—would still have to be provided with engines for the replenishing of their power.

These objections also lie against the use of caustic soda or compressed air.

Besides, after carefully investigating what could be done in other ways, I was fully convinced that I could by no other method store so much energy as by using heated water, especially as I have made it a point to design engines for my boats in such a manner that as long as I can have high pressure in my boiler I can use expansion; yet as the pressure falls in the boiler by reason of the steam being used when under water, I can regulate my engines so that they will work well down to and even below the atmospheric pressure.

The reason of all others which at once decided me to adopt the hot-water system, was the enormous factor of safety obtained by my being able to blow out by steam pressure, without the use of machinery, large weights of water, which would lighten the boat and counteract any leak likely to occur.

Finally, I preferred to use the hot-water system because, the motive power being steam, ordinary marine engineers are at once familiar with it, and would have more confidence in the boat than if any new, delicate, or comparatively untried system were adopted.

2nd. The submerging the boat by mechanical means. I feel confident that previous attempts have proved unsuccessful mainly because either they depended upon varying the displacement of the boat by taking in water to submerge her, and to regulate the depth at which they desired to operate, or they descended by steering downwards.

My objection to the first-named method of descending by taking in water, and thus increasing the specific gravity of the boat, is, that practically there is no difference of the specific gravity of water on the surface and at 50 feet depth; thus, when the boat has lost its buoyancy at the surface, it has also no buoyancy at any given depth, and the risk is thus very great of suddenly descending beyond a safe depth.

Further, by this method they relied upon some mechanical means for ascending by ejecting water. In case such mechanical means failed, the boat would be lost.

As regards the method of descending by steering downwards, I need only point out the great risk of allowing an object 100 feet long and of great weight to proceed in the downward direction even at a small angle, as the impetus gained would very easily carry it beyond safe depth so quickly that they might not have time to check it.

On the other hand, by my system I rely upon no mechanical means for rising. I keep myself, by means of the speed of the horizontal propellers and the regulators, at any desired depth, with a sufficient force to keep steady when advancing at that depth; and as I never cause the boat to leave the horizontal position, I am safe against the effect of impetus in a downward direction.

3rd. The horizontal position I have found to be a *sine quâ non* for a submarine boat, and I have already above shown the great risk in allowing the boat to descend at an inclination. I have, therefore, provided rudders which I prefer to place in the bow of the boat, and which by the action of a plumb weight are always held in the horizontal position, and, therefore, should the boat from any cause tend to take a direction other than the horizontal, these rudders will immediately bring the boat back to the horizontal position.

During experiments continued for a couple of years I have found these rudders perfectly reliable, and they have never failed to effect their purpose.

In addition to these three main features of my submarine boats there are a few more points to which I wish to direct attention.

There is really no trouble at all about the heat or the sufficiency of sound fresh air in the boats.

The heat after the 14 miles run above named was only 32° C. (90° F.), and after the first run at Landskrona, when the crew had been closed in from the outer air for three hours, the temperature was taken by two of the delegated Officers at 31° C. (88° F.), while I am informed that in some monitors the stokehole temperature rises to 49° C. (120° F.), and I suppose that it is not much cooler in some of the larger modern ironclads.

As to the purity of air, there have been four men enclosed in the boat for six hours without any appreciable diminution in the length of flame of a tallow candle placed on the floor, the level where the air should be most impure.

There is, of course, no reason why I should not carry compressed air, caustic potash, chlorine, or other well-known chemical compounds for purifying the air, in lieu of the lead ballast, except that I do not consider the complication to be necessary; as, in the case of war, many opportunities would occur for opening up the cupola for a minute, or for turning on the forced draught, and filling the boat again with pure air.

I have not had the slightest difficulty in finding crews. My first engineer was one from the merchant service, my second one was engineer in the Swedish Navy, and my third one was again a civilian; any number of stokers have always offered their services, and many Swedish Naval Officers have urged me to let them command the boat. The risk to the crews ought to be very slight, and in war I consider

that they would be safer in my boats than in many other positions. In case of accident the boat can always come to the surface and the men can escape with life-belts.

The Captain would soon be accustomed to study and become familiar with the appearance of the coast and other objects from the low level of the cupola when awash. Still, this, like all other parts of the boat, has to be studied, and men have to be trained in order to make the boat really efficient. No untrained man can hit a bullseye, or ride a bicycle, or play the piano; still they are easy things enough when learnt.

I have delayed the completion of my first boat for years in order to take away all complications. I have nothing but ordinary steam and ordinary engines; still, the engineer and the stoker should be so familiar with the position of all cocks, valves, and pumps as to find instantly and almost mechanically the right handle at any important moment.

The Officers who are to command these boats ought to study, perhaps for years, their manœuvring power, and the best manner in which they are to be made most useful in war. If not, they may fail at any moment when they are relied upon by the naval authorities. I put very great strain upon this training in good time, as I am bound to admit that any number of these boats, if constructed suddenly before the commencement of a great war, would probably not be as useful as half their number in the hands of Officers and crews who had previously become familiar with them for years in time of peace.

In training crews they would, of course, at first work for a time with the boat "awash," showing only the cupola, as, even in time of war, the boat will often be most useful also in this position.

My compasses work in the same manner as in all other iron ships; that is, they do not work as satisfactorily as when raised far above the iron—but, as they work exactly the same whether the boat is on the surface or submerged, I can always take the bearing before descending and then be safely guided by the compass below.

General Hardinge Steward has suggested to apply a telescopic mirror, and this may be very useful on occasions when the boat may not like to show its entire cupola, nor to descend altogether, but wishes to advance while keeping the enemy's ship in view with only the small tube which holds the mirror above water.

Lieutenant Hovgaard suggests that some electrical power should be carried in accumulators in addition to the steam power; this can of course be done if found useful, but I would prefer to avoid complication by carrying the weight of such accumulators and electrical motor in additional heated water.

The main safety of the boat, of course, lies in the utter improbability of the enemy knowing that the boat is near, or that any attack is intended; next, it lies in the very short period of a few seconds in which the cupola appears above water, and which would generally not be long enough to enable the enemy's guns to ascertain the range. If the cupola be hit the boat is not disabled, as there is a cover which can at once be slung across the opening and make it watertight, so that

the boat can again descend out of sight and go away to put on a spare cupola.

The actual turtle back of the boat can easily be protected against the shots of machine-guns or quick-firing guns by its being covered by a 1-inch steel plate in addition to the skin, but any shells, if they hit the turtle back, would strike at such an exceedingly acute angle that this additional weight would really not be required.

When the boat runs "awash" the water which covers the remainder of the entire boat, except the cupola, would be the safest armour that could possibly be devised.

My boats are armed with one or two Whitehead torpedoes in tubes, and as soon as my controlled electrical torpedo is ready, I propose to tow one of these as well.

This torpedo will offer the advantage that steel wire nets would be no protection against it, as the nets would be torn asunder or brought close to the ship's side by the impetus of the torpedo weighing 4 tons, striking with a speed of fifteen miles an hour, so that its charge of 300 lbs. of dynamite must explode as near to the ship as is required to make that heavy charge thoroughly effective.

To defend the submarine boat against surface torpedo boats, I mean to carry either a 2-lb. quick-firing shell-gun or a couple of MacEvoy's small spring torpedoes, besides which my boats are so strong and so handy, that they would ram and sink any surface torpedo boat with which they may come into contact.

As a large ironclad costs as much as from 50 to 100 of my submarine boats, the question of expense cannot be of much consideration, and I am convinced that as soon as different nations become familiar with the boats, and when naval Officers, by their practical use, have determined the best way of making their manœuvring most effective, they must be adopted in large numbers. As soon as it is acknowledged that the boats are safe, and can be easily managed, in consequence of my having made them simple and easily handled, by eliminating all complicated or dangerous motive powers or mechanisms, and by only calling upon the boats to do what they can easily do, without any reminiscences of the fantastic though fascinating writings of Jules Verne, it does not require much imagination on my part to see, a few years hence, great numbers of these boats defending such waters as the Thames, the Mersey, the Clyde, the Humber, the Straits of Gibraltar, the Bosphorus and Dardanelles, the Suez Canal, Rio Janeiro, the La Plata, and such ports as Portsmouth, Plymouth, Cork, Edinburgh, Hamburg, Wilhelmshafen, Copenhagen, Kiel, Carlskrona, Cronstadt, Brest, Cherbourg, Ferrol, Lisbon, Cadiz, Carthagena, Marseilles, Toulon, Genoa, Spezia, Naples, Trieste, Odessa, Alexandria, New York, New Orleans, and all the important stations and shipping ports in India, China, Japan, Australia, South Africa, and the American continents.

In almost every case, when I examine the charts of such ports, I find some especially suitable points in favour of the use of submarine boats.

I have heard the opinion expressed that the general adoption of

submarine boats may act detrimentally to the interests of this country, because the boats might enable smaller countries to defend their ports to a certain degree against more powerful navies.

It is true that the submarine boats are important in the first instance to countries which cannot afford to follow the constantly changing systems of costly ironclads—but, rich though England be, it must be important also to this great Empire, if a cheap means of defence can be worked out for her coasts, her Colonies, and her coaling stations, which would leave her ironclads free to fight on the high seas, and her swift cruizers free to follow and protect her own merchant navy, or to destroy the merchant navies and commerce of her enemies.

I have never heard it stated that the British Navy has too many modern war-ships even for these purposes, let alone coast defence, and I cannot imagine any less costly means of defence of Colonial ports and coaling stations than such submarine boats as, in the absence of fortifications, may be able to defend their commerce until there is time for the Imperial Navy to come to their assistance.

Admiral Arthur, C.B.: Mr. Chairman, your Royal Highness, and gentlemen, this is a subject in which I have taken very great interest. I do not intend to address you at any length, but there are a few points on which I think we may dwell with great satisfaction. I consider that not the least important feature of the interesting paper read by Mr. Nordenfelt to-day is the clear way in which he has pointed out to us the absolute necessity, in all vessels which navigate under water, of keeping the horizontal position. This has been the point which has led us astray with the Whitehead. If we had maintained from the first the horizontal position by means of two horizontal rudders, one at each extremity, instead of one rudder placed in the stern only, we should now be in a much better position than we are. The Whitehead torpedo is a submarine boat, and has been going now upwards of fifteen years. We have constantly strengthened it to correct the danger increased by its going at too great a depth, and we have only lately come to the conclusion which Mr. Nordenfelt has so clearly put before us—the absolute necessity of maintaining a horizontal position to prevent an abnormal dive. I have reported on a great number of submarine boats of many descriptions, but the report has always concluded by saying that I could conceive of no opportunity for using these boats with any effect whilst under water. I was one day discussing this subject with a Russian naval Officer who had commanded a submarine vessel for three years, and I asked him that question: "Can you conceive of any situation in naval warfare in which a submarine vessel could be of any use?" His answer was to the point, and conclusive; he said, "No, certainly not; whilst a submarine vessel is submerged she is totally useless. But let the submarine vessel be so constructed that she can stick with her turtle-back just appearing above water, and then I will approach the whole British fleet, and allow them to fire on me, and I undertake to get into position near enough to discharge the Whitehead torpedo." I think that is the point we must come to. We want torpedo-boats that can steam at a high speed with almost total immersion. Undoubtedly to do this they must have the power of going entirely under water, but such would be exceptional and for very short periods. My opinion is that all torpedo-boats should be submarine boats—that is to say, they must have the power of going under water if required, but they must be able to steam at a high rate of speed along the surface. I should think we may eventually arrive at being able to solve the question of maintaining the same speed they have at present, viz., of 20 knots an hour; we should get that at a light draught, for which purpose some alteration in the position of the screws would be necessary, then with the turtle-back awash we should get 13 knots—and we may be quite satisfied with 6 knots or less on total immersion. I think those

are the two principal points that we have to dwell on to-day. You will all agree with me that the system of drawing a vessel down instead of guiding her down is the one we must rely upon. That is one of the most novel points in Mr. Nordenfelt's design, and I think it is the most important one.

Admiral the Right Hon. Sir Astley Cooper Key, G.C.B., F.R.S.: In any remarks that we may make on this very interesting paper that we have heard read by Mr. Nordenfelt on a somewhat startling subject, I at all events will speak with very great diffidence on the points raised, as I have never seen anything in the shape of a submarine locomotive at work. Mr. Nordenfelt has had actual experience in the management of one of them for some years, and he speaks, therefore, not only from the sources of his great knowledge and engineering skill, but with the great power of practical experience. I may mention that Mr. Nordenfelt has in his historical summary omitted to include an invention of a submarine boat which was considered to have been of considerable importance during the Crimean war; it was proposed by Mr. Scott Russell, one of the most eminent engineers of the day. It was thought highly of by the Government, and Lord Palmerston, then Prime Minister, sanctioned an expenditure of 7,000*l.* on its construction and trial. Sir James Hope, Sir James Sulivan, and I were appointed to report on its capabilities. I need scarcely say that it was a failure, but it serves to illustrate the great advance that Mr. Nordenfelt has made in the submarine boat he now proposes. I did not like the look of Mr. Scott Russell's vessel. It was merely a large diving-bell, like an inverted boat. Ten men were supposed to go in it. It was to be lowered by admitting water into a compartment, and to be raised by pumping it out or by blowing it out with compressed air. It went down to the bottom with the men under it; they were to walk on the bottom and propel the boat by pressing against thwarts fixed to the under side of the boat. The boat looked rather doubtful as to its rising to the surface, having a long strop and thimble attached, and a buoy with long buoy-rope. The boat went down and remained there twenty minutes; a tackle was sent down hooked to the strop, and up came the boat just in time. They were bold enough to try it a second time, but with no greater success. The second time it came up suddenly, blew like a whale, and capsized. I mention this to show that many years ago the submarine boat was considered an important weapon of offence; in that case it had a special object. As I have said, in any remarks I may make on this proposal I do it with great diffidence, but I do not think Mr. Nordenfelt has paid sufficient attention to the necessity for speed. He says that when floating on the water she will go 9 knots, and therefore when she is totally immersed she will go faster. I should like to see this proved—until then I question it—and I think it is of importance. The armament of this boat is one Whitehead torpedo. If she is to attack by creeping up to a vessel (which I think is by far the surest plan) it must be to a vessel at rest. If a vessel is at rest she will probably have her nets out, against which a Whitehead torpedo of the old type has very little effect, and thus you have a most formidable vessel only armed with one Whitehead, against which a ship at anchor is quite protected. If, however, the ship is under way and has greater speed she can of course escape from her assailant.

Mr. Nordenfelt: The larger boat runs 12 or 13.

Sir Cooper Key: I should be very pleased to see the larger boat. There are one or two questions I should like to ask. I think it is a matter of very great importance, as Mr. Nordenfelt has pointed out, that the smoke is discharged under water; but I should like to know, when it is so discharged, does it make its appearance at the surface?

Mr. Nordenfelt: It bubbles a little, but no smoke comes out.

Sir Cooper Key: I should be rather afraid that it might appear on the surface, and thus indicate the approach of the vessel.

Mr. Nordenfelt: Not when it is under the water.

Sir Cooper Key: You say she can be sunk to a safety depth: does that safety depth mean that beyond it the body of the boat will be crushed or altered in shape?

Mr. Nordenfelt: It means that the buoyancy would be taken away.

Sir Cooper Key: Those are two points I wished to know. As regards the compass, which it is suggested might be a difficulty, I do not believe you will find

it so, because Sir William Thomson's compass when used on an ironclad surrounded by iron in a conning-tower works satisfactorily.

Mr. NORDENFELT: I was told the same thing yesterday: I was not previously aware of it.

Sir COOPER KEY: I do not think there will be a difficulty on that point. The most important point connected with submarine boats is that which has been pointed out by Admiral Arthur. In our investigations on the boat I have referred to during the Crimean war, we came to the conclusion that it would be perfectly useless, because you cannot see under water sufficiently to guide you to any given object. In Mr. Nordenfelt's boat there is no means of seeing under water; therefore I believe that unless you can approach a vessel with your cupola above water, to see where your enemy is, and the direction and distance you should steer, you will not effect much. You might approach it this way during twilight, or by night, or in a fog without much difficulty. I doubt whether anyone would go down under water and fire the only implement of destruction he possesses at a vessel that he does not see; but I do think that with the cupola above water, or with the smaller cupola and projecting mirror, it would prove a very formidable means of attack. I think the principles which Mr. Nordenfelt has adopted—in the first place having his stored energy in such a simple medium as hot water, and in the second place having the means of raising and lowering the boat by the mechanical means of vertical screws and bow rudders—are both sound and admirable. We have heard much nonsense talked about regulating the depth by the specific gravity of the boat when under water. If, however, she is made heavier than the water, down she goes to the bottom. If she is lighter than the water, she comes to the top. Without mechanical appliances there is no reliable means of keeping her at a fixed distance below the surface or having it in your power to raise and lower the boat with regularity. I believe that this submarine boat has a great future, and that Mr. Nordenfelt has achieved a great success. As I have said, the question of speed is one to which a little more attention might be paid; and it must also be borne in mind that when you are going to fire a torpedo you must see the vessel you are going to fire at.

Vice-Admiral H.R.H. DUKE OF EDINBURGH, K.G.: Sir Andrew Clarke and gentlemen, I am very glad to have been able to be present to hear this lecture of my friend Mr. Nordenfelt, who has already done so much for science and for the improvement of many matters connected with warfare. I may say that I fully agree with Sir Cooper Key, who has just said that Mr. Nordenfelt has done very much towards solving a problem which is likely to be of great importance in future naval operations. He has had the great advantage of practical experience with these boats, and they have so far proved a great success over all preceding attempts to manufacture a submarine boat. There is one point which I think Mr. Nordenfelt's experience has not tested, or in which he has not already gained experience—and it is one which might be raised in a discussion like the present. We have not heard in the lecture—nor has it been in any other way mentioned—in what manner the torpedo is to be delivered against the ship. It has already been said that when you are attacking a ship absolutely at rest, which means a ship at anchor, having risen to the surface and taken your exact bearings, you may with a tolerable degree of certainty be able to strike the vessel, provided the power of the torpedo is sufficient to force in the nets and burst near enough to the ship. But not having heard it stated in what manner the torpedo is to be discharged, it strikes me that the submarine boat may get so near to a ship that when the explosion of so large a charge as 300 lbs. of dynamite takes place, the people in the boat or the boat itself may be destroyed by it. I say this, because in the Service we never should dream of exploding a large charge of dynamite if we had divers down within a very great distance, and those who have seen submarine mines exploded will know at what an enormous distance fish are destroyed by them. That is owing to the simple fact—which has been more or less described by Mr. Nordenfelt himself—that water is of the same density at all distances; in other words, it is an incompressible substance, and a blow struck at a certain place is transmitted a very great distance before its effects are in any way diminished. I feel, therefore, that it is extremely desirable that experiments should be made before risking the lives of men in a boat of this descrip-

tion for the purpose of seeing whether they would suffer in the way I have alluded to. When turret-ships were first constructed, an experiment was carried out, if I mistake not, at Spithead, on board the "Royal Sovereign," where they put goats, cocks and hens inside one of the turrets, and fired the gun to see the effect that the explosion would be likely to have upon the gun's crew. An experiment of a similar nature might be tried with the submarine boat. I do not mean that goats or cocks and hens should be put under water for any length of time, but remembering the example I have given of fish being destroyed at such an immense distance, you might have vessels containing fish placed at certain distances, and in that way ascertain the destructive limits of the explosion. I merely throw this out as a suggestion, but I think the point is worthy of consideration. I will only add how very much I have enjoyed listening to this lecture, and how heartily I wish success to the invention which Mr. Nordenfelt has brought before us.

Admiral Fremantle: I rise simply to ask a question on a point which I think Mr. Nordenfelt did not explain to us, and which has not been touched upon by other speakers. I wish to know the method of discharge which is to adopted for this torpedo below water, and also whether it would have any effect on the horizontality of the boat when it is discharged, because, as Mr. Nordenfelt has told us, it is a very great advantage to keep the boat in a horizontal position.

Admiral Selwyn: Mr. Chairman, your Royal Highness, and gentlemen, I admire, in common with most of the gentlemen present, the extreme ingenuity that Mr. Nordenfelt has displayed in this comparatively new subject, because he has been the first to consider the whole of the forces in operation, which a great many of us have left unattended to. I am afraid, I must confess, that in some parts of it, I myself, in designing some years ago a submarine boat for the Turkish Government, also relied upon man power, but I did so because I never intended that it should be used for anything but cutting off submarine mines. In that boat we proposed to use sulphate of soda for the absorption of the carbonic acid, which I believe is by far the best—Glauber's salts—and I have no doubt that would meet all the requirements in a very small boat. Mr. Nordenfelt has now taken us into the consideration of how big we may make these vessels. He has begun with a very practical and useful illustration, but he has forced us to consider that there is scarcely any limit to the size to which we may usefully take this vessel. It at once supersedes in a very large degree the necessity for armour or for considerations of that kind, and eventually we may have to acknowledge that Jules Verne was not very far wrong when he led us in a submarine vessel all round the ocean. The question of propulsion at a high speed is one which has recently approached solution more nearly than we have ever known it before. At the Inventions Exhibition a steam-engine was shown for the first time which combined enormous speed with great economy. Our rotary engines in the past have given us great speed, or up to what we called great speed—that is, up to about 1,000 or 2,000 revolutions a minute. This engine, the invention of Mr. Parsons, the son of the late Lord Rosse, for the first time gives us high economy—21 expansions, which is very high economy indeed in an engine which is capable of 16,000 revolutions a minute. Now this is a question of propulsion which is very easily understood when we consider that one immense difficulty has been to obtain reciprocating engines which would drive at high speeds, and drive a small screw of this kind at high speeds such as we desire, without too much liability to breaking down. This, which belongs to a certain extent to the class of rotary engines—but is more a turbine engine than a rotary engine—is free from all those objections. It is visible now at Lincoln's-Inn, where it lights the whole of the establishment and gives double the number of electric lights for the same boiler power that any other engine does. This is an enormous improvement, and I could not suggest to anyone a better means of measuring the actual effect produced than that of the increase in the number of electric lamps. While our indicator diagrams are liable to a great many errors, the number of electric lights you can burn from a given power is liable to no such error—it is an absolute measure of efficiency. With such an engine there seems to me no great difficulty in driving a vessel of this kind at any speed that any torpedo-boat has ever yet attained. I should be disposed to say that a very little further consideration would lead to the banishment of the screw altogether, and to a speed very much

exceeding that which has already been obtained by torpedo-boats. That torpedo-boats would also rise in speed considerably is of course to be expected, but that would at once meet the objection to the low speed already attained. With simple means such as Mr. Nordenfelt has used, I do not see that we can find fault with the speed of 9 and 13 knots. I think we ought to congratulate him that he has done so well. I also see no reason, derived from the increased frictional surfaces, why the speed obtained under water should not be greater than that obtained above it, for the bow wave, which has long been known as an enemy of high speeds, which prevents a torpedo-boat obtaining any great speed till she begins to ride upon it, is clearly absent when you drive a vessel of this shape entirely under water. The fish is endowed with a perfectly devised shape for the work it has to do under water, and when we imitate a fish above water I think we very often commit a grave error. When Mr. Nordenfelt devises a submarine boat, he naturally adopts the submarine form, and I think very wisely does so. With regard to the procedure above water within the distances at which I presume Mr. Nordenfelt would use the torpedo, I really do not see that there is any great difficulty in setting a course—considering the current and other circumstances—very nearly as well as he could above water. I believe the faculty of rising is most important, and that it has been accomplished in the most perfect manner by Mr. Nordenfelt's device of the vertical screw; but that there is any grave difficulty other than that which must necessarily accompany fogs and darkness in successful attack by a torpedo, I really do not see. I think Mr. Nordenfelt is to be congratulated on having made an enormous step forward, and one which I am sure has a great future before it.

Admiral Boys: There are two questions that I should like to ask, but I will premise by expressing my thanks to Mr. Nordenfelt for introducing this subject, and complimenting him on his invention. It is not like very many inventions that are brought before us, and which simply exist upon paper; but here is an implement that really exists that Mr. Nordenfelt has to a certain extent perfected. He has built it and worked it. I am sure he is anxious for criticism, because by asking questions about designs, and pointing out what we may imagine to be their failings, inventors and gentlemen like Mr. Nordenfelt are able to make improvements and perfect them. One question I would ask is, what depth of water Mr. Nordenfelt thinks is necessary for the navigation of his larger vessel, because it appears to me that the immunity of a vessel from the attack of these boats will depend to a great extent upon the shallowness of the water she may be anchored in. I should also like to know how the torpedo is placed in the discharging tube which I see in the drawing; must it be placed there before the vessel is started? And then, how he proposes to discharge two torpedoes, because if there is only one tube——

Mr. Nordenfelt: There are two tubes.

Admiral Boys: Is one below the other?

Mr. Nordenfelt: They are parallel to one another.

Admiral Boys: I may also point out that this larger vessel gets to a considerable size, and the actual pointing of the torpedo depends upon the pointing of the vessel. The vessel is actually submerged until she gets within striking distance, then rises to discharge her torpedo, and that appears to me to be rather a difficult point.

Captain Curtis, R.N.: I should like to supplement Admiral Boys' question by asking how far the submarine vessel must be from the ironclad for the torpedo to strike it, because if it is any distance off at the angle it is laid at, it seems as if it would be likely to go under the vessel. Also whether by its being so close to the vessel would the pressure of the water be likely to compress the submarine vessel. Then I should like to know whether in a rough sea the water does not come through the funnel.[1]

Mr. Nordenfelt: There is no funnel.

Captain Curtis: Does Mr. Nordenfelt contemplate the use of torpedo-nets of any depth in estuaries to counteract the effect of his torpedo-boat? I anticipate the time when ships will not carry their own nets and spars, but will be accompanied by covering ships laden with tubes that will fit into one another, fitted with

---

[1] I should have said, when not awash running above water in a rough sea, is the sea liable to enter the aperture where the draft is forced through?

jackstays and nets to them. Fleets will be eventually folded, as you would fold sheep, with openings for ingress and egress. If a ship is to carry all the torpedo-defence gear that I understand they have in present use, perhaps some younger Officer, who is more acquainted with the subject than I am, will tell us how long it will take to get a ship ready for action in case the fleet is suddenly attacked when off a port. For my own part I think it will take some considerable time under such circumstances to prepare for action.[1]

Admiral Gore Jones: His Royal Highness has touched upon the fact of the torpedo-boat being very likely to get too close, and has suggested that something in the shape of nautical cocks and hens or fish were to be put up to test that. Now I can state from actual experience that that has been actually tested in America. Experiments have been tried in New York with crates and crusher-gauges and other appliances to find out how far the different explosives would act at different depths and distances, and on one occasion when these experiments were being tried a large school of porpoises was seen approaching. The Officer waited until the porpoises were within 200 yards of the 200 lbs. of dynamite, and then fired it, and in an instant the whole school of porpoises were up in the air, going round and round like flying fish. Three dropped dead on the water and the others were lying helpless and were secured for oil. This will show pretty clearly what the tremendous effect of a large explosive charge in water would be, and I mention it as a practical thing that has been tried. Not that I am at all afraid of a submarine boat getting too close to the enemy. If a small boat blows up a big ironclad I think she will have expended her life most happily. I am not at all afraid of it. But if they do get too close there is no doubt there is a great danger, as His Royal Highness has pointed out. With regard to the submarine boat, I really know nothing about it, and therefore shall not attempt to speak upon it.

Major-General Hardinge Steward, R.E.: I had the pleasure of seeing this experimental boat tried in Sweden in the autumn of last year, and, on the whole, I think almost all the Officers were very much impressed with it. We saw it on the last day of the trials, under the most unfavourable circumstances possible—that was in a dead calm. The water was as smooth as glass, and a Spanish Torpedo Officer who was on the yard-arm said he could see the torpedo-boat approaching at a distance of 500 metres. He made a great point of this, but the boat was running near the surface, and its general position was known, so I think you will all agree with me that the precise case may not occur again. The boat was a small boat, but I understand that Mr. Nordenfelt has designed a larger one. Since I saw the boat, torpedo tubes have been added to the bows, and I do not see any reason why they cannot be very well used. Some speakers have referred to the danger that may arise by the explosion of a charge of dynamite under water while the boat itself is under water, but I do not apprehend any danger at all. I have been assured by an Admiral now here, that on one occasion when a small charge of 60 lbs. of gun-cotton, such as would be used with the Whitehead torpedo, was fired at Portsmouth, a diver was accidentally below water and within 100 yards of the charge, and nothing happened even to the glass eyes of the helmet, though the diver felt the vibration of the water. The charge which destroyed the porpoises, and which Admiral Gore Jones has mentioned, was I expect a large ground mine fired by the land engineers. I was very pleased to hear what Admiral Arthur said about boats of the kind now under consideration being used principally for running *on the surface*, and I hope that that will be their future *rôle*. It is all very well to say that you can do a great deal of business with an ordinary torpedo-boat that runs 20 knots, or even with the second class boats, but unfortunately we have not got enough of these boats. If under fairly favourable circumstances you are going to attack vessels lying in the offing a few miles from the entrance of a port, you must expect a loss of 30 per cent. of the boats you use; that means that if you take five

[1] I am of opinion that merchant steamers should be laden with torpedo defence materials and accompany fleets; when they come to, off the enemy's port, working parties from each ship should be sent on board to get their portion of the defence material and fix it where required—"Nets break a heavy sea."

you may lose two, and if you take eight you may lose three, and even then you run the chance of being beaten off. But, as a member of the Council of the Naval and Volunteer Defence Association, I have to consider with others the defence of commercial harbours, and I have also to deal with the defence of Colonial ports. I am in a position to state that many of our ports do not possess even the proportion that is to go to the bottom. It comes to this, that if you want to economically defend a port, it is better to have a boat that does not show at all. Then, another thing one must remember, and that is that the moral effect of this boat would be enormous. I am perfectly certain that foreign war vessels would not lay off a port to intercept outward and homeward bound vessels if they knew that there was a submarine vessel inside that could come out without being seen. I certainly think that 10,000*l.* would be very well spent in providing a vessel of this class.

Mr. Anderson, C.E.: I am afraid I cannot say anything of interest on this subject, except to state that it is well known, through the late Mr. Froude's investigations, that a fish-shaped vessel under water is in much more favourable circumstances for obtaining high speed than any vessel on the surface of the water, because it is established theoretically that a vessel of easy lines completely submarine meets with no resistance at all except the skin friction of the water, no resistance, I mean, such as that which arises from the bow wave, and therefore I believe that if Mr. Nordenfelt will apply a little more ingenuity and perseverance to the perfecting of his boat, the result will be the attainment of a very high speed under water, and consequently a most formidable vessel. It seems to me also that the precaution which Mr. Nordenfelt has taken against the danger of the vessel continuing to sink, as it would naturally tend to do in consequence of the contractions of volume due to the increased pressure arising from increasing depth, will be found to constitute the cardinal features in submarine boats.

Mr. Nordenfelt (in reply): His Royal Highness has drawn attention to several very important points which I could not very well put into the lecture, and upon some of which I, not being a sailor, must speak with a considerable amount of diffidence. To begin with, as to the question of resistance—the difference of resistance when going below and when being on the surface—in a submarine boat the resistance differs so much from that in a surface boat that I should like to draw attention to it. In the first instance, in my boat the additional surface immersed when it is under water to that which is immersed when she is running awash is extremely small. In an ordinary surface boat the portion immersed is very small, but the portion above is comparatively immense, and if you go down another foot you increase the surface friction tremendously all along the boat. In my submarine boat you increase it very little, as it is only the small top of the turtle-back which is out of water when the boat is on the surface. As Mr. Anderson is good enough to say, I believe it is absolutely proved that with this sort of lines the speed below for a given consumption of fuel to a given boat must be greater than the speed above. The factor of safety of course is manifold. Safety as against general risks of seamanship, of being struck or striking the bottom, or anything of that kind, I have endeavoured to ensure by making the boat very strong and also by the fact that if my machinery fails I float up. As long as my regulator acts I cannot go below the point at which it is set, and then I have a very large proportion of water which I can blow out under high steam pressure by simply turning a couple of handles. I quite believe that by degrees we may find means for increasing the factor of safety, but I think for the present that is sufficient. Then as to the risk which a boat would run in discharging a torpedo against a ship. I am not aware that anybody has fired Whiteheads from a submarine boat. No doubt the boat which sank the "Housatonic" went down with her, because carrying nothing but a spar torpedo she had to run close up to the attacked ship, but now when you fire a Whitehead you can of course determine the distance which you consider safe, and I hope the English Government, or any other Government, will carry out systematic trials to determine that point, probably arriving at the conclusion that a Whitehead carrying from 30 to 60 lbs. of gun-cotton must not be fired at a shorter distance, say, than 50, or than 100 yards, and that a torpedo like my controlled torpedo, which will fire 300 or 400 lbs., must not be fired within 300 or 400 yards. My controlled torpedo can be steered, but the Whitehead is not steered, and they will have to

determine at what distance a Whitehead cannot miss the side of a ship; I should say at 200 to 300 yards. I therefore consider that a Whitehead can safely be discharged from my boat, but I speak of course under correction, depending upon trials to come. I hold that I can always stop the boat in time, because during the last 1,000 yards if I run from 3,000 to 1,000 awash, and at the last 1,000 yards if I run below I know my speed, my number of revolutions, and my time, and I ought to be able to calculate the distance so far to a certainty that I cannot come within 200 yards. I should know the time it takes a certain given number of revolutions to move the boat about 800 yards. If, however, there are very strong currents where I cannot control the boat, I can always at the last moment run up to the surface and fire from there. One Officer spoke about the effect of having a fixed angle for firing. The angle need not be fixed, because I can have a screw to raise one end if I want it, but generally 10° to 12° is the angle given to a torpedo, as I fire under water and at short range 4° to 5° will probably be found sufficient. We might be at a longer distance than I meant to fire it; in that case it would be safer to have the torpedo laid at a smaller angle. If I do not feel certain of my position I can always come up, see where I am, and if I am too near go down to retire, and if too far either fire where I am or go down and advance. The net, I believe, is supposed to hang 30 feet down. Of course an ordinary Whitehead could not be used when the ship lies still, supposing the net to be efficient. If a ship moves, or if a number of ships move together, I do not suppose they would have the nets, and if they moved in narrow waters they certainly would not carry nets, because of the difficulty of steering. I suppose a number of ships together would not move at much more than 7 or 8 knots, and in difficult water, at 7 or 8 knots, the nets down would very seriously interfere with the steering and cause risk of collisions. However, I do not want to be brought to-day into the net question. If a ship lies still with a net which keeps off the Whitehead, of course my Whitehead is kept off in the same way as a Whitehead fired from a surface boat; but if I fire one of my own controlled torpedoes, which weigh 4 or 5 tons, with a striking velocity of 15 miles per hour, the inertia must necessarily either tear the net to pieces or bring the net so close to the ship that the very heavy charge of dynamite will have its effect. As to the danger of the discharge of the torpedo doing harm to the submarine boat, the effect of the explosion is generally up and down, and its horizontal effect is very much smaller. I am speaking generally, as I have not before me the figures of any actual experiments. I am certain, however, that the horizontal distance at which a submarine boat would be safe is very much smaller than one imagines from the general effect dynamite has against ships. If a dynamite charge is exploded 50 or 60 feet out, the effect upon a ship would be very slight; I believe you have to get so near that this angle of effect in water strikes the ship almost directly upwards, or at very short distances horizontally, otherwise the effect would be very small. But I say this, if the Whitehead when carried by my boats cannot pierce a net, I should be as bad in this respect as the Service boat, but not worse. I should think the trials as suggested by His Royal Highness could very well be made. You can enclose animals in something which has exactly the same strength as my submarine boat, then fire your torpedo at 100 yards and see the effect upon them. You can in that way very easily find out at what distance the torpedo would be dangerous, and then Officers and men would be trained not to run the boat nearer than the limit of distance thus determined. I believe that Professor Abel has already made a number of experiments to determine the strength and direction of the effects of these explosions. I can, of course, make a boat with a very much larger reserve of buoyancy when going down than I have at present. I have the reserve buoyancy very small, in the first place because the boat being thus more sensitive I can control her better; and, in the second place, because whatever buoyancy I have I must have my horizontal propellers strong enough to pull down against it. If I have these propellers much more powerful it means that I consume so much more steam for that purpose than I do now, that is, I diminish the distance for which I can use stored steam to drive my boat, I lose some of the steam in holding myself down that might be used for going forward; but in the 100-feet boat of course there is a tremendous superabundance of steam, and very likely it will be found I can have the horizontal propeller so strong that the safety will be very much increased. Sir

Cooper Key referred to Mr. Scott-Russell's boat. I am very sorry I never heard of it, if I had, I should have mentioned it; but I should say that the form of an inverted open ship of course takes away all possibility of surface speed.

Sir Cooper Key: It was simply a large diving bell.

Mr. Nordenfelt: It takes away the possibility of living in a bad sea in hard weather, and also the possibility, which I look upon as a most important matter, of being able to run 100 miles or so in a night previous to the attack. It brings the question back to what Admiral Arthur said was the old idea, to have something which went down and did its work, without actually providing a means of running a long distance before that time. I believe that in making use of submarine boats to replace surface torpedo-boats, the long previous surface run is absolutely necessary; you cannot do without it. I fully admit the value of Sir Cooper Key's prediction, that I shall soon give much greater surface speed to this class of boat. The two boats now building will give fully 12 knots per hour, and if, as General Steward proposes, these boats are used to move and to fight "awash," and are not to submerge entirely, except for the purpose of safety if detected, I am quite prepared to lengthen the boats to 130 or 140 feet, and to give them 17 knots surface speed, when the small cupola would run very little chance of being hit. About the speed below I cannot be wrong; anyhow, it can easily be found out. I have not made any real under-water speed trials, and I do not mean to do so. I do not think it is fair to call upon my civilian employés to make trials, the risk of which I cannot previously ascertain; that will be done safely by degrees by some naval Power who can afford such trials. Admiral Arthur mentioned that the boat will be very useful when she runs awash, and he went still further and said probably she would never be used otherwise. I should like nothing better than that the boat should be used awash; I mentioned in my lecture she would be very often so used, but I still feel that if I had come before you and said only, "I have a boat which shows very little above the surface compared to other boats," you might not have come to listen to me, whereas, when I discuss a boat that actually has gone below, you are good enough to come. I also feel that although a good deal of work will be done awash, still if, as I believe, when an enemy comes too near me, if I am not in a position to attack him, it is a very important fact that I can go down 15 or 20 feet, and lie at the bottom in shallow water until it gets dark, and then come up again. In the large boats the men can live about 10 or 12 hours without outside air. In carrying Admiral Arthur's idea a step further, and in looking to the probability of some of these boats being used exclusively as surface boats, with only a small portion of their turtle-backs showing out of water, I can easily see how extremely useful they would be as scouts. With their smoke blown out under water as I do already now, and with 15 to 17 knots speed, they would be the very best and safest scouts that can be constructed—they would fulfil a great want for keeping the touch of the enemy, report its movements, and generally act in supplying news to the Naval Intelligence Department in the flagship. This is a most important service for which secrecy of movement is of great value, and which cannot be done as safely or as well either by launches or by the surface scouts, whose chimneys and smoke reveal their existence and movements at very long distances. I believe Admiral Boys asked a question about the depth of water; what I would propose would be this: the Captain ought to know the depth of water, and if it is more than 30 or 40 feet, he will have to watch carefully the security-regulator. If the depth is not so great, he need not watch it at all. You can go clean down and not stop till you get to the bottom; then of course you cannot advance because of the friction of the bottom, but you have always full control over the boat. I hold very strongly against the old idea of getting so near a ship as to go under it, or letting go anything that floats up to its bottom, or endeavouring to project anything at a short distance, with the idea that it should affix itself to the ship. It is all very well with a wooden ship if you can screw a wire into it, but not with an ironclad. It would bring in such a tremendous factor of uncertainty, that I would not like to take it up at all. As to the light, we have never been down more than 16 feet, but at that depth there is plenty of light from the surface of the water. The mirror of the surface throws a very strong light inside the boat. You cannot see fore and aft except at the angle, at which the water above you, acting as

a lens, reflects objects on the surface. What that angle is I have not ascertained absolutely, but it is a tolerably large angle. You cannot see far forward at all, and you cannot see far astern, it is as black as ink, you can only see a sort of segment. You cannot see forwards, that means that you cannot safely advance at great speed under water, that holds at least until it has been proved to the contrary. It is impossible to think of a submarine boat as a boat that actually manœuvres and does its work under water; I gave that up from the very commencement. I do not believe for a moment that a man can go down and steer about for great distances, and attack right and left; the risk is too great. He should run awash and then he would see where he was. Off Landskrona it blew like furies and every wave went clean over the cupola. The boat went close round the "Osborne," and between her and the Swedish "Edda," and manœuvred perfectly, so that there is no trouble in seeing when you are awash; it only requires training. That is the position in which I would like to move about and do the work, and not till I was so near that I could be seen, would I go down. Of course, I would not attack in brilliant daylight, and I would not attack quite alone; I would send some boats on the other side of the ship, or do something else to create a diversion. I do not admit that I can only attack a ship that lies still, because as I can move awash at fully 12 knots with my large boats, I can follow up the movements of any number of ships blockading or bombarding. I do not believe that any squadron afloat ever manœuvres under fire faster than 6 or 8 knots when blockading or bombarding; at any rate I am not tied to attack only stationary ships. Then about discharging the torpedo; there are the tubes, one above the other.

Admiral FREMANTLE: Is the torpedo protected?

Mr. NORDENFELT: Oh, yes, in regular tubes. There are two ways of doing it. With the small torpedo, and the mode I have indicated of attacking, I always mean to be nearly abreast when I discharge, crawling forwards; when I do fire I am practically still. I therefore have a number of openings, especially towards the rear part of the tube, which let in water. There is water in constant communication with the screw of the Whitehead, and therefore I require no propelling power, other than its own screw, for discharging the Whitehead. It has been proved by the French Government that Whiteheads can discharge themselves out of tubes if water is provided, even at a resistance of $7\frac{1}{2}$ to 8 knots speed. As I never imagine that I should fire at speed under water in that boat, I discharge it simply by her own screws. Also in the larger boat I propose to discharge them simply by their own screws, but there is no reason why I should not apply steam for discharging, not letting the steam act directly upon the Whitehead—because I would lose so much steam by the condensation—but by acting upon pistons which press upon water and the water to drive the torpedo out of the tube. That is, however, a complication which at the present time I have not thought necessary to use.

Admiral BOYS: How do you propose that the crew shall get air?

Mr. NORDENFELT: We had at Stockholm four men absolutely locked up for six hours.

Admiral BOYS: Where do you get the air?

Mr. NORDENFELT: In the boat. The actual cubic space in the small boat is sufficient for four men for six hours, and not only enough for six hours, but you could not measure the diminution of the length of the flame of a tallow dip that was down at the bottom of the floor, whereas the men are higher up where there is less carbonic acid and less impurity in the air. I hope that with the interest which has been shown in these boats—three of which have been already purchased from me—we shall be able to bring to bear upon the subject the intelligence and great experience of naval Officers, and by that means get over a great many smaller points that I feel can be easily settled by lengthened experience. When that is done I believe the boat will be very much better appreciated than I as a mechanician can possibly make it in its early stage.

The CHAIRMAN: Your Royal Highness and gentlemen, it is past the usual hour at which these meetings close, and even if I felt inclined, I should not detain you by any remarks of mine. I had the opportunity of seeing this boat on the Swedish coast, and of being present at the trials. I have also had to report to the Government the result of these investigations, and without saying whether that

report was favourable or not, I will only say from the criticisms that have passed —especially from the distinguished naval Officers who have addressed this meeting— that if my report has been a favourable one I have not erred in their opinion. I think the highest compliment which I can possibly imagine to Mr. Nordenfelt and to this invention was the criticism which we heard from the most distinguished scientific authority in the Navy of the present day—I mean Sir Cooper Key, who apparently entirely accepted the practicability, the security, and safety of this vessel, and whose criticism was limited to the question of speed. I think that shows that evidently, as far as practicability for warfare is concerned, this submarine boat is pretty well accepted by the profession. The only other observation which occurs to me is this. I do not myself attach such very great importance to this invention as a powerful means of submarine defence in English waters. I believe we have a great deal to learn in this vessel with reference to overcoming tidal currents and currents when submerged. In smooth calm waters where there is an absence of tide and current, I believe it is a very formidable machine, and although General Hardinge Steward alluded to the facility with which this vessel was seen in a glassy sea, I can only say that when there was the slightest ripple on the water at distances of 200, 300, and 400 yards, it was very difficult to distinguish. Therefore, as a craft not altogether wholly submerged, but just a boat awash for coast defence and also for the attack of ships at sea, and especially in heavy weather when the fast torpedo-boat cannot act, I believe this vessel will be found of great practical and reliable service. I will not detain you longer, but will ask you to give me permission to convey our best thanks to Mr. Nordenfelt for his very interesting lecture.

Colo

SOM

By

Th
Arun
the B
regim
Office
the fi
that

The
infan
the f
take

Ev
in th
to c
carry

In
regin
the
recru
to fu
num
emp
num
shou
whic

It
over
was
there

N
1st,
to ?
"firs

Friday, February 12, 1886.

Colonel Sir LUMLEY GRAHAM, Bart., Vice-President, in the Chair.

SOME SUGGESTIONS AS TO THE BETTER TRAINING OF OUR INFANTRY.

By Major C. Arundel Barker, 2nd Battalion Royal Irish Fusiliers.

The Chairman: Ladies and gentlemen, I have to introduce to you Major Arundel Barker, who is going to read a paper entitled "Some Suggestions as to the Better Training of our Infantry." Major Barker is an Officer of considerable regimental experience. This Institution always specially welcomes regimental Officers who speak upon questions connected with their own duties. It is, I believe, the first time that Major Barker has given us a lecture, but, having read it, I know that it is an interesting one.

There can be no doubt that our present system of training our infantry soldiers, both at home and abroad, but more particularly in the former case, is considered very unsatisfactory by all Officers who take an interest in their profession.

Even granting that the system was everything that could be desired in the case of regiments at home—and it is those only that I propose to consider in this paper—there would exist grave difficulties in carrying it out.

In the first place, their establishment—except in the case of regiments shortly about to go abroad—is very small, and owing to the short service system they must contain a large proportion of recruits. When in addition to this it is remembered that they have to furnish large drafts every year to the battalion abroad, and that numbers are daily taken away for duty, regimental or garrison employ, and for the various classes of instruction which are so numerous now-a-days, it ceases to be a matter of surprise that there should be no men left to learn that preparation for the time of war which should in reality be the end and aim of our whole system.

It is a fact, that out of a regiment with an effective strength of over 600 I have seen a Commanding Officer's parade where the band was stronger than the whole of the rest of the parade, and where there were hardly as many privates as there were Officers.

Now, the objects which I propose to set before myself are:—1st, How are we to get a sufficient number of men to teach anything to? and, 2nd, What are we to teach them? on the old principle of "first catch your hare and then cook it."

Although the Military Prize Essays for 1885, published in the Journal of the Royal United Service Institution, do not refer directly to the depletion of regiments at home, yet indirectly they bear upon it in a very important manner. If the recommendations made by the majority of essayists are carried out—as undoubtedly they will be to a greater or less extent—the time for which a soldier engages to serve in India will be considerably extended, and therefore fewer men will be required each year to replace the loss occasioned by men who take their discharge or are transferred to the reserve. At present a regiment, whose linked battalion is in India, has annually to send out a draft of some 150 men, and the drain this causes upon a home strength of only 560 privates may easily be imagined.

If by extension of service in India this annual drain be reduced, regiments at home would, of course, have considerably more men left for drill purposes.

Again, a large number of men, especially in garrison towns, are taken away for guard duties, and when this is the case they are not, as a general rule, available for morning parade for two days in succession. The duties on guard are very easily learned, and it is not necessary that a man should go on guard once a week or oftener to keep up his recollection of them. There is no duty which a soldier dislikes so much or which tells in such an injurious manner on his health. It is quite certain that guard duty is one which contributes more than anything to lessen the popularity of the Army, and yet numbers of guards and sentries are mounted every day which could, without the slightest inconvenience, be abolished to-morrow. Cannot we take a lesson from civil life in this matter? Does a manufacturer, for instance, who has a large amount of valuable property lying in his yard post sentries over it? Not he! He considers he has taken ample precautions if the premises are locked up at night, and a watchman makes an occasional round. But not content with posting sentries over everything which can or cannot be taken away, we put whole guards in places where the work would easily be performed by at most two men. At every military hospital, for instance, is a guard. What for? The main reasons, as stated in the order board, are to prevent any improper articles from being passed in to the patients, and to keep the latter from leaving the premises. But round nearly every hospital is a high wall with a gate, where a single man on gate-duty would answer all purposes.

It may seem something like high treason to doubt the necessity of a barrack guard, but I think that an inlying picquet, occupying the guard-room at night, but allowed to go to bed, would fulfil all requirements, and would only take men from parade for one day instead of two.

The number of orderlies, too, which have to be furnished by a regiment appears excessive. In a large garrison town where there are several regiments I have known as many as twenty-five taken daily from one corps. In these days of frequent posts, telephones, &c., much of the work now done by orderlies might be relegated to them; and though Staff and Departmental Officers might be unwilling

at first to part with men who are a convenience in many ways, they would doubtless soon come to see that it was for the public advantage.

The gymnasium and great gun drill also often take a number of men away from parade. Would it not be possible so to arrange that these should be mainly carried on in the winter, and only in the afternoon or evening in summer, so that a Commanding Officer might, at any rate, have his men to himself for the whole morning in the drill season?

Winter is the time in which we get most of our recruits, and as much as possible of their preliminary training should be got through before the summer commences, but a great deal of time is often lost in bad weather owing to there being no covered place to drill them in. This difficulty could and ought to be met by having a drill-shed—it need not be an elaborate one—in every barracks.

Another plan for getting a respectable number of men together is not so much resorted to as it might be, *i.e.*, early morning parades. In the first place, one can have all the men about to go on guard, and, secondly, the orderlies, tailors, shoemakers, subordinate clerks, &c., who need not as a rule commence work very early in the day, and to whom, especially for those who have sedentary occupations, an early morning parade would only act as a freshener. But what makes a Commanding Officer hesitate to order these latter to attend parade is not so much the time they would be absent from their other duties, as the time they will take to clean their accoutrements afterwards.

By substituting brown leather for buff and adoping a button which does not require constant polishing, the waste of time incurred by the occupation aforesaid might be reduced by one-half.

Lastly, it is evident that the more simple and easily learned a recruit's drill can be made, the more quickly will he be able to take his place in the ranks, and the more time he will have available for practical training; but I will only touch on this subject here as I propose to go into it more fully later on.

Now, having tried to show how a certain amount of the raw material might be obtained, it remains to consider how it is to be worked up.

If any one who has taken the trouble to listen to the preceding remarks imagines that the object of all this is to turn out an ideally smart regiment, one that can advance in line like a wall, and execute all the most difficult manœuvres in the "Field Exercise" to a hair's breadth, he is very much mistaken. The single aim I have set before myself is that to which I have alluded before, viz., to make the soldier as efficient as possible in time of war, and in all that follows I have tried to keep this object steadily in view.

Not long ago appeared a small book entitled "The Fighting of the Future," by Captain, now Brevet-Major, Ian Hamilton, which strikes the keynote of what our system of training ought to be. There is no doubt whatever that he is perfectly right in his contention that a soldier who has been so trained to handle his rifle that he is perfectly confident that he can hit anything, whether stationary or moving, at a reasonable

distance, is worth half a dozen of our present ordinary rank-and-file. I would wish nothing better than to see the system of musketry training which Major Hamilton advocates adopted in its entirety; but it would be perfectly impossible to carry it out unless there were a rifle-range within easy distance of every military quarter in England. This means a very large expenditure of money which it would be hopeless to try to get out of the British taxpayer unless a sharp defeat sustained by our troops should bring home to him its necessity, so that for the present we must be content to hope for better things and make the most of what we have. There is a great difference between various stations as to their suitability for carrying on musketry instruction. At some the rifle-ranges are quite close to the barracks, and would permit of the men going out to shoot at any hour of the day; at others they can only be reached by a march of four or five miles or by rail. At the former places a more extended course of musketry, on the general lines laid down by Major Hamilton, might be provided for, with, of course, a larger allowance of ammunition, and these stations might be reserved for regiments first on the roster for foreign service.

Again, when on account of the paucity of troops in England—as during the late war in Egypt—or for other reasons, it is possible to choose between two stations, preference should be given to that which offers the greatest facilities for musketry instruction. It is impossible to turn out first-rate shots without plenty of practice on a range, but the introduction of Morris's tubes has opened a great future to the improvement of rifle shooting. Ranges for these may be made anywhere and at very small cost, and no barracks should be without them. A certain amount of ammunition, say 200 rounds per man, should also be provided by Government, for some men take no interest in rifle shooting, and they cannot be ordered to shoot with the Morris's tubes at their own expense. Practice with these tubes does not teach the soldier to make allowance for the wind, or to meet the recoil of his rifle, but these are not hard to learn, and I am persuaded that by their constant use the shooting of bad or indifferent shots might be improved fully 50 per cent. Moving, and appearing and disappearing targets can quite easily be arranged at very small expense, so that every description of shooting can be provided for.

Nearly every change in musketry instruction of late years has been in the right direction; but regimental Officers—and they certainly ought to know best—are almost unanimously of opinion that the abolition of musketry instructors is a mistake. It is perfectly right and proper that Officers commanding companies should put their own men through the annual course of musketry, and most of those I am acquainted with, would not wish for anything else, but the want is much felt in regiments of an Officer whose business it is to look after the whole department of musketry instruction.

Under the present system, *vide* "Book of Musketry Instruction," the responsibility is divided between the Commanding Officer, the second in command, Officers commanding companies, and the Adjutant; but "what is everybody's business is nobody's business," and when

anything special has to be done, such as arranging rifle matches, or the selection of teams for rifle meetings, &c., there is no one who feels that he has any responsibility connected with it.

The special object of a Captain is to get his own company to shoot well, and it is not in accordance with human nature to expect him to take the same pains with casuals, who may, perhaps, belong to a company he is trying to beat, as with his own men; but the ambition of a musketry instructor is that the whole regiment should have a good figure of merit, and the casuals might safely be left in his charge. Besides which it is notorious that the training of non-commissioned officers and recruits, the supervision of markers, musketry fatigue parties, and care of ranges, are not as efficiently carried out under the new arrangements as they used to be. The way in which the figure of merit of a battalion is calculated, has varied so much in the last few years that it is difficult to compare the shooting of one year with that of another, but it is a matter of general opinion that the shooting of the majority of regiments has fallen off since the abolition of musketry instructors, and this too at a time when not to go forward, is to go backward.

I have placed musketry training first in the order of things to be taught to a soldier, and urged that our troops should be quartered, as far as possible, in places where every facility exists for carrying it out; but fortunately such places will generally be found best adapted to what comes next in importance, viz., his training in all duties in the field. For this purpose the barrack square, which is in many places the only provision, is almost worse than useless, for all the conditions are as different from what is likely to be met with in actual warfare as they well could be. Instead of practically unlimited space with every variety of ground, is a miserable plot, perhaps 200 yards long by 100 broad, level as a billiard-table, and inclosed by high walls.

If anything more than elementary drill is attempted, such as outpost duty or the drill of attack, the proper intervals have to be sacrificed, and Officers and men get into a cramped and finicking way of working. The fact is that for every 100 yards further that the rifle carries, we want a proportionate increase of space in our drill-grounds, and though 200 yards might have been quite sufficient for the Brown Bess, a mile and a half is not too much for the Henry-Martini.

It is much to be regretted that the Government has so few large spaces permanently at its disposal for camps of instruction. Aldershot and the Curragh are excellent in their way, but only a small proportion of our troops at home can be quartered in them. If additional camps were formed in places where they were most wanted, such as in the midland counties and the North of England or South of Scotland, many regiments now quartered in the heart of densely populated towns might be sent there, and the sale of the land on which the barracks stood would probably cover the cost of the purchase of such waste lands as are best suited for a camp, and of the erection of huts for troops upon them.

An incidental advantage of these camps would be that they would

afford increased opportunities for our militia and volunteers to work in connection with the regular troops.

The month's course of military training of soldiers instituted in 1883—which I may briefly state provides for instruction in attack and defence of positions, outposts, advance and rear guards, escorts, hasty entrenchments, duties in camp, the elements of military bridging, &c.,—is very useful, but unless large areas such as I have mentioned above are available, it cannot be properly carried out. Another thing which goes far to do away with its good effects is the ridiculously small number of men which a Captain frequently has at his disposal. How can outpost duty or the drill of attack be done properly with fifteen files? Yet that number is by no means uncommon. To remedy this, I would suggest that a whole wing of a regiment instead of one company should be struck off duty for a month, the company going through the annual course of musketry, and all duty men, orderlies, &c., being taken from the other half battalion, which might easily be done if some of the measures recommended in the early part of this paper, were adopted.

For the first week companies might be left to their own commanders, but for the remaining three they should be worked as much as possible together, under the command of the senior Major or Captain. In this manner there would be a sufficient number of men to furnish two parties to manœuvre against one another, and to carry out outpost duties, &c., in an intelligent manner.

No larger provision of tents or entrenching tools would be necessary, as the companies could use them in turn. It would be a great assistance to Officers when lecturing to their men, if a set of illustrations of hasty fortifications, knots for military bridging, &c., were provided for use in the lecture room.

Now, supposing that a regiment in which every available man was kept in the ranks, was quartered in a station close to a rifle range, and with plenty of open ground in the neighbourhood, how much time should be devoted to those barrack yard manœuvres which now form the principal serious occupation of the soldier? I emphatically say —and I am by no means the first to say it—as little as possible. They are only means to an end, and as long as that end is attained, the simpler the means the better. Besides which, a man who has always been accustomed to feel a comrade touching him on either side as in ordinary drill, is apt to lose confidence in himself when fighting in the loose order necessitated by the precision of modern firearms, and only constant practice in extended order will ever make him self-reliant. A certain amount of drill in close order is of course necessary for the line of march and for the preliminary movements of a battle; there are also certain exercises in the use of the rifle which are absolutely necessary, but the two principal books "published by authority" for infantry, contain a good deal which is of no practical use in time of war. As the soldier would have quite enough to keep him fully occupied in other ways, I propose to glance through the books above mentioned and try to find what might advantageously be omitted. We will begin with the smallest, the "Rifle Exercises."

Turning to this, we find the first thing taught is the "manual exercise." In the book before referred to, "The Fighting for the Future," Major Hamilton condemns, as it appears very justly, the first movement in this exercise, the "Present arms." He contends that it takes a long time to learn and is quite unnecessary, since if the "Shoulder" is good enough as a salute for a Captain or a subaltern, it is also good enough for Officers of superior rank, giving as an example, that in civil life a man makes no difference in his salute between a noble and a commoner.

No one will pretend that the "Present" is any use in war, and if we can do without it in peace, it is a pity to retain it at all.

The next thing we arrive at in the Rifle Exercise, is the Funeral Exercise, from which the "Reverse arms" and "Rest on your arms reversed" might easily be omitted without detracting anything from the solemnity of the occasion.

The 8th Section is "Preparing for cavalry," which it is thought might be left out as a separate exercise altogether. Bayonets can be fixed at any time, and the front rank now always kneels at the command to fire. Placing the butts of the rifles on the ground renders them useless for firing purposes for the time being, and though every writer on tactics, at the present day, demonstrates the impossibility of unbroken infantry being successfully attacked by cavalry, in this exercise it is assumed that cavalry will be able to approach so close that it will need a regular fence of bayonets to keep them off.

The following Section, No. 9, is the "Feu de Joie." Here again is an absolutely useless exercise which requires a great deal of practice, and therefore takes up time which could be much better employed. Firing volleys by companies from right to left and back again from left to right, would be quite as effective, and would require no additional training. Lastly, comes the Bayonet Exercise, which, though of very little use for the purpose for which it was originally intended, may perhaps be retained as a good gymnastic exercise, strengthening the arms and generally exercising all the muscles of the body.

In the same volume as the Rifle Exercises, is Musketry Instruction, but this certainly does not err on the side of containing unnecessary matter, and is, besides, in process of being rewritten, so we will now pass on to the Field Exercise. The first part of this book is devoted to those elementary movements which have to be learned by all recruits before they can take part in company or battalion drill, and there is very little here which can be omitted, but I think the balance step and the slow march are both superfluous. A man can be taught to walk properly without making him stand on one leg whilst he pokes out the other backwards and forwards, and the slow march is evidently not required for anything but show.

In company drill also there is not much to find fault with, as almost all the different movements would be useful on service, with the exception indeed of marching past, but this, in spite of the enormous amount of time wasted over it, can hardly be dispensed with, as it possesses certain advantages of its own, and is the cause of much innocent amusement to the British public.

Countermarching, now that ranks can be changed at will, ought to die a natural death.

In the formation of a company in extended order, are given no less than seventeen bugle sounds for as many different movements. These take a long time to learn, and indeed never are learned by men who have no ear for music. I speak feelingly on this subject, for after eighteen years' service I do not know them all now. But at page 211 it is expressly laid down that calls on the bugle are liable to be misunderstood, and should seldom be used except for purposes of drill, while at page 227 we are told that during the advance for the attack there should be no bugle sounds. The question is obvious, Why have them at all? And indeed I think that the principle of teaching men to do a thing one way at drill and another way before the enemy is a most dangerous one, and the very way to throw them into confusion at the critical moment. Some bugle sounds are useful for many purposes, and we could not well do without them, but I think that the following, *i.e.*, the Advance, Halt, Fire, Cease fire, Alarm, and Charge would be found sufficient.

It will probably be alleged that with the long distances between the extended line, supports, and reserves, it would be difficult to communicate a command to them all without bugle sounds, but this can be done perfectly well and in a far more soldier-like way by a system of signals, some of which are already given in the Field Exercise, and which only require to be supplemented by one or two more. I have never seen this system applied to a regiment, but I have worked a company with extended line supports and reserves in this manner, and found it answer admirably.

Coming now to Battalion Drill (General Rules), I have no hesitation in saying that the sooner mounted Officers cease to be employed in giving points the better. To begin with, we are told (page 106) that directly the battalion comes within range of the enemy's rifles they are to dismount, and I presume they will not be required to give points then.

In the second place, I have never observed that a regiment drilled by the Adjutant, or sergeant-major, drills worse than when there are mounted Officers, and indeed my experience is that they drill better without them. At brigade parades, mounted Officers are a continual nuisance, as they are always getting in the way and preventing the markers from seeing when they are covered.

With regard to the various battalion and brigade exercises contained in Parts III and IV, it is thought that all might be omitted which come under any of the following heads:—

1. Those which are of no practical use.
2. Those that can be done more simply another way.
3. Those which were originally intended to be carried out under fire, but which are now—owing to the precision and rapidity of modern firearms—quite out of the question.

Under the first head I have classed the following:—

(*a.*) All movements in half-column (page 133) double companies, and in direct echelon of companies (Part III, Sections 33 to 35).

Half columns are never used by any chance, and though double company formations take up a great deal of room in the Drill Book, surely two companies could, if necessary, act together without necessitating such movements as "Forming line to a flank from columns of double companies," and "Advancing in double fours from the centre."

The original intention of having battalions in echelon was to enable them to protect their own flanks, or the flank of the brigade, according to circumstances. This would now be effected by having a company or a battalion in attack formation on the flank to be protected. It may be occasionally desirable for brigades in the second line to have a battalion thrown back on a flank, but there does not appear to be any necessity for echelon of companies.

(*b.*) Most of the instructions regarding the colour party. Regiments are not now allowed to take their colours with them on service, and even in times of peace they are only taken out on very rare occasions; so it would be quite sufficient to lay down rules for the movements of the colour party in marching past and other purely show manœuvres.

(*c.*) A battalion in line advancing in column from a central company (Section 23—2); and forming column on a central company (Section 25—2); changing front on the march (page 190).

All the above movements are apt to cause confusion, and are never used except for drill purposes.

(*d.*) A brigade changing front, the whole in echelon (Part IV, Section 16).

This manœuvre to be carried out at all requires a perfectly flat and unbroken plain, and the chances of finding such a place on service are too remote to be taken into consideration.

Under the head of "Movements that can be done more simply another way," may, I think, be placed—

(*a.*) "Advance in column." / "Open to column: rear companies halt." } Part III, Section 11—5.

These can be done in both cases by "Opening to column from the rear company."

(*b.*) "Break into column to the right, or left" (Section 21—1, 2). Column can be formed from line much more quickly and simply by wheeling the companies to the right or left.

(*c.*) A battalion in column forming line by companies in succession to either flank (Section 27).

Line may be formed to either flank by simply wheeling to the right or left into line, and it cannot be a matter of great importance whether the order of the companies is inverted or not.

Lastly come those movements originally intended to be carried out under fire, but which are now quite out of the question. These are the most mischievous of all, for it is simply a case of teaching our men "How not to do it."

(*a.*) Battalions in line relieving one another (Part III, Section 8).

It is now laid down as an axiom that troops once engaged cannot be relieved, but under what circumstances could it be necessary for

regiments to relieve each other in this formation unless they were engaged?

(*b.*) A battalion in line retiring from one flank in rear of the other, or from both flanks in rear of the centre (Part III, Section 24, and Part IV, Section 12).

In these movements part of the line is supposed to be covering the retreat of the other, but anything more clumsy cannot well be conceived. Imagine at the present day a battalion retiring under fire as above described. It would be a case of getting out of the frying pan into the fire, for instead of receiving the enemy's fire in line, which would be bad enough, it would be exposed to it in deep column, which would be infinitely worse.

(*c.*) Prolonging the line to either flank (page 161).

The object of this movement apparently was to withdraw troops in action from a part of the line where they were not wanted, and to transfer them under cover of the rest of the line to the other flank. If this were attempted now they would probably suffer very severely during the operation without being able to return the enemy's fire till they had gained the further flank.

(*d.*) A battalion in line forming square (Section 37) and forming square four deep (Section 38—2, 3). These formations are now admittedly only useful against savages, and even then square would never be formed from line, nor would a four-deep square be formed by the outward wheel of sections.

The only remaining portion of the Field Exercise on which I have any remarks to offer is Part VII, Miscellaneous Subjects.

The first thing here alluded to is the inspection of a battalion, which one would naturally think would lay down some sort of standard for a General to go by in ascertaining the fitness of a regiment for active service, but in the seven pages devoted to this most important subject, the only exercise alluded to which would be of the least use in time of war is the firing exercise.

Prince Hohenlohe, a very distinguished German Officer, has said that the way in which a battalion is habitually drilled depends entirely upon the character of the inspections.

If an inspecting Officer is content with marching past, bayonet and manual exercises, and a few antiquated manœuvres, Colonels of regiments will go on practising these *ad nauseam*, and will only devote an odd day or so to practical work. The "Inspection of a Battalion," as it now stands, seems to lend the stamp of authority to the method above mentioned, and it is thought that it might be rewritten with great advantage.

Section 14. "Guard Mounting and Trooping the Colour" is a relic of the ante-Crimean days when our troops had nothing better to do. It is happily hardly ever practised now, and might safely be relegated to the limbo of defunct ceremonies.

In the foregoing suggestions regarding the simplification of drill, there are probably many faults both of omission and commission, but it would be easy to appoint a committee of experienced Officers to settle these questions, and I have no doubt that their decision would be

very much in the same direction. Even were drill reduced to a minimum, it would in conjunction with musketry instruction and training in field duties afford ample occupation for the whole of the summer months, and the winter should be specially devoted to all those branches of a soldier's education which can be taught under cover. Shooting with Morris's tubes, school, the gymnasium, lectures on elementary tactics, &c., afford profitable occupation for wet days, whilst fine days are available for ordinary parades and route marching. This last might, I think, take place with advantage twice a week, once in marching order and once in drill order. It is not only good practice in marching but tends to keep the men in health.

I will now bring this paper to a conclusion, only remarking that I believe it is quite possible for our infantry as now constituted, to attain a much higher degree of efficiency at a very small increased cost, and I do not despair—if only military men will keep hammering at it long enough—of the country being brought to see that, in the long run, nothing can be falser economy than having to pay for indifference in time of peace by ruinous expenditure in time of war.

Lieutenant-General Lord Chelmsford, G.C.B.: Sir Lumley Graham and gentlemen, I think we must all admit there is a great deal of truth in the strictures Major Barker has passed upon our present system of drill and training, and there is a great deal that might be altered with considerable advantage to the Service. With regard to the paucity of men available for drill, there is no doubt that the present system is a terrible drawback to battalions at home. I do not see how it is to be got over so long as one battalion is to be made a feeder to another battalion abroad. I can only assure Major Barker, with regard to his lament over the number of guards and orderlies employed in our different garrisons, that I believe every General who has ever commanded a brigade at Aldershot, or at other camps, has done his best to reduce their numbers, but somehow or other there is a *non possumus* that crops up on every occasion, and no reduction is ever made. I hope Major Barker's paper may be useful in causing some remedy to be found for that very serious evil. With regard to musketry practice, the great object of our training ought to be to make our men shoot better. At the present moment the whole subject is under the consideration of the authorities at Aldershot, General Feilding being the President, and I am in great hopes that the practical men who are considering that subject will be able to devise a system of drill and musketry instruction which will enable us in the short space of time which the British soldier now is under his Captain's command, to improve his shooting and make him a really efficient soldier on active service. With regard to the Drill Book, no doubt at the present moment it does contain a number of manœuvres which are certainly not necessary for active service; but, as one of the old school, I must remind Major Barker, and those young Officers who are anxious to go ahead into the attack formation almost before the recruits really know their right hand from their left, that it is a very important matter to teach men good steady drill first. It is the foundation upon which everything else is built up. If you neglect that and go into that loose system of drill which I know a great many advocate, impatient, and very naturally impatient, of the old Frederick the Great precision which used to be our standard of high efficiency, I quite admit that you may arrive at getting your men to move very rapidly, and bring them up to the higher part of drill instruction in a manner which will apparently in peace-time be satisfactory enough; but if those men are trained during peace-time in a loose manner you will find when we come to active service that they will not move, and will not be as reliable on the move in open formations as they would have been if more attention had been paid to them in the closer formations. You must recollect that our boast in the old Peninsular War was that our men could always advance and attack in line. The

French never could do that. Why? No doubt the character of the individual soldier had something to say in it, but I believe it was a great deal due to the different system of drill. The French habitually drilled loosely, and when you saw them marching or manœuvring, although they got over the ground quickly, they did so at the expense of all steadiness and precision, and in a manner totally opposite to our mode of proceeding. You must remember the attack formation at the present moment requires exactly the same amount of precision and steadiness as did the advance in line of former days. It is in fact much more difficult, and requires thoroughly trained men who have confidence in themselves and in their leaders. I may be doing Major Barker injustice in imagining for one moment that he wants to do away with steady drill altogether, but as one of those who have been brought up under the old system, but who at the same time has always worked the new system with perfect confidence, I would wish to take this opportunity of most earnestly deprecating the idea that by teaching ordinary drill loosely and hastily, good results can be obtained. With regard to inspections, I quite admit the system might be much improved. Too much stress is laid upon marching past, and consequently too much time is given up to practising it. I should like to see an order issued forbidding Commanding Officers of regiments to practise marching past at their ordinary drill parades. At the inspection a march past would then become a test of the manner in which the battalion had been instructed in the ordinary drill manœuvres. There is no doubt that our Drill Book needs revising, and that it contains a good deal which is of little advantage in the training of our soldiers for active service. When, however, as is so generally the case, there is merely a barrack square to drill our men in, variety in steady drill manœuvres becomes almost a necessity, as to go on grinding away at the same movements is very monotonous and distasteful to all ranks. I trust that the authorities will consider the subject matter of this paper, and that some benefit may accrue from the discussion of it in this theatre.

Colonel Davies, Assistant Adjutant and Quartermaster-General, Southern District: I am sure we are all much indebted to my friend Major Barker for bringing this very interesting subject before our notice in the excellent lecture he has just given us. On a great many points I quite agree with him, though on some I do not quite agree. With regard to the unsatisfactory state of the present training of the British soldier, I think we must be all perfectly agreed. The gallant Chairman will correct me if I state what is wrong, but I believe that our men get less training than in any of the Continental armies. This can never be improved till the financial authorities at the War Office and the House of Commons itself recognize the fact that more money must be laid out before we can possibly give men the extra training they require. Of course we are desirous to get the men as much off duty as possible, and to see them in the ranks. No doubt in these days of short service it is of the greatest importance that none of the men should ever be out of the ranks, if possible, on field days. I think the guards might be cut down, and I look upon sentries, though no doubt very ornamental, as, generally speaking, very useless, and, I believe, instead of having the regular sentry as we do now, if we had flying sentries, our barracks, hospitals, and magazines would be far more safe than they are at present with a sentry who is obliged to take up his post in one place and is not able to move. There is one way in which they may get more men in the field with the battalions, and that is by arranging for all the public duties to be done by one battalion each day, instead of having a certain number of men taken out of all the battalions, which is the usual plan. Of course the shooting, too, is most important, but there again we are in the very greatest difficulty in this country, because it is almost impossible to get good ranges. I do not agree entirely with Major Barker about wishing to see the musketry instructor revived; I think it is far better that the company should be trained by its own Officers, and I am quite sure that if the musketry instructor be revived it will all fall into his hands, and we shall have the old system, which certainly was not a good one. With regard to the training that came into vogue in 1883, I believe the idea was excellent, but I do not think it was ever fairly and properly carried out throughout the Army. In the first place, the first arrangement was telling the Captains to begin drilling their recruits from the beginning, putting them through the goose step. We know very

well there are very few company Officers in the least suited to this work, and I should have been very sorry if, when I was commanding a battalion, I had found my company Officers devoting themselves to the duties of drill corporals. We know we are fortunate if we have two or three good drill sergeants or corporals in a battalion, and that then the drill of the recruits will be far better carried out under the Adjutant by these sergeants or corporals than in any other way. And I think before the men are handed over to the Captains to train they should be considered perfect in the use of their arms and in the close order drill; then the Captains are the people who, under the eye of the Commanding Officer, should carry out the further instruction of the soldier in musketry, extended order drill, outpost duty, &c. Major Barker says it is better to strike off half a battalton instead of a company. That is not going far enough. In larger stations I see no reason why a battalion should not be struck off duty, because its instruction, to my mind, should be carried on entirely under the eye of the Commanding Officer, who should be out every day, and all day, seeing what his Captains are doing, not interfering with their training, but giving them every assistance he can by suggesting schemes to work upon, and pointing out any mistakes he may think they make, and taking care that the whole battalion is tarined on the same system. I think if that could be carried out there would be a great deal of good work done, which I am afraid has not been the case hitherto. Of course, as Major Barker has remarked, in most places in England there is a great difficulty in getting ground, and he suggested that the barracks should be sold and camps formed. I do not think this would be possible, you cannot do away with barracks in their present places, but I think that if the War Office would allow a little money to be spent, arrangements might be come to with the farmers, who would, after harvest, for a small payment, allow men occasionally to work over their ground, and a great deal of useful instruction might be gained in that way. Major Barker deprecates too much barrack-yard drill. We may have too much, but we may have a great deal too little, and he will find if he attempts to take men out and to place outposts, or work in extended order over rough ground, before they have been carefully drilled on a parade ground, they will not do their work efficiently. I know many think that you can take your men out to some extended position and place your outposts at once; if you do, you will find the young soldier will scarcely know the meaning of outpost duty, and will when on sentry very likely face the wrong way. You must work them beforehand in the barrack-yard. With regard to inspections, I think nothing can be more utterly absurd than the inspections of the present day. They do not test the efficiency of the battalion in the least. Many a battalion that has the best report from the General at an inspection may be one of the most inefficient in the Army, because they can do nothing but march past, and are not practised in the more important parts of their duty. With regard to striking out a number of the manœuvres from the Field Exercise Book, as Major Barker proposed, I do not think I quite agree with him. I am not going *seriatim* through all those that he has mentioned, but I think most of them should be retained. I think it is necessary that a battalion should be able to be manœuvred in any position in which it may be placed. One thing is a little lost sight of, and that is that the English Army cannot be trained quite in the same way that a Continental army is trained, and for this reason, that a Continental army is not likely to fight against any but an European nation, and therefore they must fight in extended order; but that is not the case with the English Army, we have a great deal of savage warfare, and anybody who thought of attacking Arabs or Zulus in attack formation would commit a great folly, and would court disaster; therefore we must go on with steady drill, and shoulder to shoulder line, because in fact we have more fighting with savages than we are likely to have with European nations. I think the tendency of the lectures delivered at this Institution has been sometimes rather to lead people to believe that we need not have steady drill, and that we may rush on anyhow. That is quite a mistake, as Lord Chelmsford has said. There is nothing that requires more careful drill than the attack formation, in which it is of the utmost importance that the men should keep their direction and distances; if they go straggling all over the place, what a mess you will get into if you are attacking with a large body of men. Of course, with a battalion working by itself, if you do get half as much

extension again as you ought to have it makes no difference; but if you are a part of a Division or Corps d'Armée, and a battalion takes up 100 paces more than it ought to do, what is to become of those next you? You will get into the greatest possible confusion. With regard to the bugle sounds, I have suffered like Major Barker. I do not know them all: I know a certain number, quite enough. There is a little difficulty though about signals. I am a great advocate for signals, and I have worked them a great deal, and have found them most useful on outpost duty; but a Captain cannot signal to his fighting line, because they have their backs turned and won't see his signals, and now that we extend half a company in front and half a company in support, I do not think there will be any difficulty in the Captain giving his commands to all his men if he will put himself in the proper place, not placing himself close in the fighting line, which ought to be under the command of a subaltern and the section leaders, where he can see nothing, but by taking up a central position between his fighting line and support, where he can exercise control over the whole of his company, I think he would then have no difficulty in giving his orders. Therefore I think we may do without bugle sounds, and I do not think the signals are of very much use in the extended order.

Colonel MONCRIEFF (Scots Guards): Sir Lumley Graham and gentlemen, I do not wish to trespass upon your time by going through this lecture *seriatim*, as I think that after what Lord Chelmsford and Colonel Davies have said it has been very well criticized. The only thing I wish to say is, what perhaps some of you may not know, that at present the Commanding Engineer in London is preparing some screens which are an adaptation of those used in Belgium for ranges, and they will soon be put up at Wormwood Scrubs; and it is hoped prevent the bullets going into the convict prison. If these screens turn out a success it appears to me we shall be able to have ranges almost anywhere. A few yards in front of the firing point there is a screen with a longitudinal aperture of about 10 inches. Through that space the man firing can see the top and bottom of the target, and by that means quite sufficiently to miss the target as easily as he ever did before; still if he touches the top of the lower edge of the aperture the bullet is deflected upwards on to an iron plate and falls harmlessly to the ground; if it hits the top edge of the aperture it is deflected downwards, and so cannot get away to the front or side. I think with that improvement the musketry instruction difficulty will be practically overcome. With regard to what Colonel Davies said as to working your companies, I had some experience in that in winter time some years ago. I found that the Rev. E. W. Warre, now Head-Master at Eton, was able to take his Eton boys over almost any of the farms about the country, and with his help I took my battalion to ground we had never thought of being permitted to use. We occupied miles of undulating grass land and did no harm to it at all. The 1st Life Guards provided the cavalry for both sides, and the Eton boys fought against my battalion. It appears to me that this might be done anywhere: it only wants perhaps a friendly visit on the part of the Commanding Officer to the farmer, and as far as I could ascertain in those parts the farmers were only too glad to welcome the soldiers at that time of the year, when they were under proper control. I am quite certain that public-spirited farmers at the proper time of the year will cheerfully co-operate with Commanding Officers, and will thus materially assist in the training of our soldiers.

Colonel G. P. EVELYN: Perhaps like my old brother Officer, Lord Chelmsford, I may be considered one of the old school when I regret that the tendency at present is to do away almost entirely with what I consider very important, steady drill, by rushing our recruits and young soldiers into extended formations and also by carrying on our musketry and target practice in the same harum-scarum way. We let our men fire at enormous ranges before they are able to hit at short ones. We seem also to forget two very important facts: that the object of the soldier in action is not to fire away an enormous number of rounds, but to place one round successfully. If every man who went into action could only place one shot effectively he would do more than his share of injury to the enemy; but we load our men with cartridges; we let them fire at enormous ranges, though we know their fire is perfectly ineffective; and, strange as it may be, there can be little doubt I fear that on service our infantry fire is less effective now, less destructive to an advancing

enemy, than it used to be in the days of muzzle-loaders. I think that is very much due to the action of the smoke caused by rapid firing, and also to a fact which is usually overlooked, namely, that rifles are masked if men are not in good order. If your line has intervals in some places and is crowded many deep in others, a great many of the rifles become useless because the men mask each other's fire. That shows the enormous importance of steady drill. I look upon it that if men are taught to use their arms properly, to understand the use of their sights, to bring the rifles well to the shoulder, and to keep their proper place and space in the ranks, they shoot quite effectively enough for soldiers of the line, and probably better than if they had been all marksmen who could win prizes at shooting competitions but had not done plenty of drill. Firing at long ranges and quick firing are the two things that destroy the efficiency of our infantry. Those are the two points we have chiefly to consider. I was glad to hear the last speaker express the opinion that our authorized formation of attack, of which we have heard so much of late years, is utterly useless before the charge of an uncivilized force; but I venture to remark that it has taken us some time to find that out; we did not know it at Isandlana; we did not know it at Maiwand; we did not know it at Ahmed Khel. In the latter action I think we put ourselves in the order of attack according to the book with our firing line, our supports and reserves. We were going to attack the enemy in his entrenchment position, but the enemy not understanding our game took into his head to attack first. Down they came on us; we had to reinforce our firing line with the supports and then with the reserves; our companies, battalions, and brigades were intermixed, and instead of having a good line to oppose them we had a line ten deep in some places, and with large intervals in other places, and utterly unable to manœuvre. The attack was thrown back with extreme difficulty, and it was very near ending in a catastrophe. That was entirely due to our applying to savage warfare principles which may probably be sometimes applicable to regular warfare, but which are quite unsuited to repelling hordes of Afghans, Zulus, or other savages. That having been discovered I hope we shall not make the mistake in future. I must say that we ought to fire at short ranges and not at long ranges, and I believe the great bulk of our practice should be at small targets at short ranges. If we kept to that we should no longer have the great difficulty we have at present in finding ranges in this thickly populated country. The system of screens, though well known in Italy, Switzerland, and all over Europe, has never yet been adopted by us, and foreigners look with surprise and wonder, as I know by what they have said to me, at the cool way in which we fire at Wimbledon. They see a thousand ladies and gentlemen within a few yards of the line of bullets, and they say that alone sufficiently shows them the extraordinary steadiness and nerve that must be possessed by our Volunteers. They would be afraid to trust foreigners or their own people to shoot under such circumstances—which indeed does look extremely dangerous. I believe any man who can put nine bullets out of ten into a target the size of the crown of a man's hat at 120 yards shoots quite well enough for any purpose whatever, and all the long-range shooting that we hear of occasionally as being useful, as for instance the case which occurred in the Franco-German War, was none of it aimed fire. I believe that in the few instances that long-range firing is useful on service it will be found to be an aimless fire, merely to deluge the ground with bullets without any special aim. Short ranges and small targets should be our plan, and steady drill, and by all means never mix up companies and battalions in the attack. Troops should be kept in close formation as long as they are not within the enemy's sight. When extended they suffer much more from random, long-range fire.

Lieut.-Colonel Rt. Hon. J. H. A. Macdonald: Sir Lumley Graham and gentlemen, it would not be possible for me to use language of exaggeration in expressing my feeling of great satisfaction at hearing an Army Officer deliver in this theatre such a lecture as we have heard to-day. And I feel that in saying that I am expressing not only the opinion of myself as a Volunteer, but the opinion of the great body of Volunteers who, though many of them may be very bad judges of such subjects, have at least the advantage of being able to look at such matters as amateurs, and therefore free from the fetters of preconceived notions. It fills us with delight to find that within the British Army itself is rising up a call, a strong call, and a

well-expressed call, for things for which the critic has for the last 20 years been persistently endeavouring to obtain a hearing. I think you, Sir, have long held that many things in our Drill Book ought to be simplified, and, above all, there is one thing you have pleaded for, which I am sure if it is pleaded for in the right sense must ultimately obtain success, viz., that men when they are moved should not move by mechanical touch without the aid of the eye, but should invariably move with an interval, and exercise their judgment and their intelligence, and acquire the habit of moving correctly, though moving with an interval. And I must say that I think there is a use of words in reference to drill as between what is called "loose drill" and "steady drill" which is entirely erroneous and misleading. The suggestion that if you begin to drill and drill always with an interval, your drill must therefore for that reason be loose drill is I consider a great mistake.[1] Now let us see what necessarily must happen in every war in which a civilized country may now be engaged. It necessarily happens that if two civilized nations are opposed to one another in war with the weapons we now have, that the one which has to approach the other must approach the other for at least a mile and a half in an order with intervals between the men. That is the condition of combat up to the moment when you are ready to charge at full speed and to take the position. Every man who has to cross that mile and a half must do so with only the eye as a guide, with the assistance of course of the supernumerary rank to prevent general drift. Now the means by which we shall prevent confusion caused by drift and the line getting too thin at one place and too thick at another, and thus prevent one regiment overlapping another and taking up its ground—an evil referred to by Colonel Evelyn—is by training men persistently and constantly at marching and doubling with an interval between the files, and teaching them to observe that interval correctly. I maintain that is what you require to do in your barrack-yard by the most exact and steady drill, but if you put the men together with their elbows rubbing one another, and teach them to march in that way, you are not only giving them no aid to learn the mode in which they must pass the fire zone, but you are on the contrary introducing a principle which is absolutely inconsistent with what they have to do on service. The principle of marching with touch is for the express purpose of preventing the men exercising any intelligence as regards interval—preventing the men using the eye at all—every man being in fault in the ranks when he is out of touch. His business is to find his man if he loses him by feeling for him. We all know that that is not what he does when on service. We know if you were to teach men no steady drill but that of marching by touch, that you would not be teaching them the mode of movement used in war. The moment you get to Aldershot, or the moment men are put into a ship to go out to war, from that moment to the day when they come home, they never do march by touch. I have seen battalion after battalion pass me at Aldershot marching in column, and the men do not march by touch; they march as men of sense always would by keeping reasonably near, but every man having freedom to clear himself of the obstructions before him, and having freedom to use his lungs, which he cannot possibly have with his arms close by his side. The natural action of swinging the arm in walking is not an action of a mechanical nature for the purpose of helping the body forward—we all know that it cannot do that; the action of the arms is perfectly involuntary, and is the means Nature provides for keeping up the circulation in the arms. If a man holds his hand hanging straight down, the whole of the veins of that hand immediately swell up and the hand becomes uncomfortable. If he swings his hand two or three times without raising it at all the blood resumes its proper circulation and relief and comfort are the result. In the old days it was perhaps advisable to sacrifice some of the advantages of following the natural course for the purpose of obtaining what you then wished to obtain; you wished to present the appearance to your enemy of a wall that nothing could throw down, and which also moved like a wall, and as it advanced was so solid that it would push down—morally and even physically push

[1] "Loose" in the sense of "irregular" or "inexact," is to be shunned as ruinous. The word should never be used as it is ambiguous. "Open" would be much better.—J. H. A. M.

down—that which was in front of it. You cannot produce that result now; your wall must be carried forward in bits and put together at the last moment. It is impossible for you to cross the fire-swept zone as a wall, and therefore the sooner you abandon the idea of working as a permanent wall at any time the better. Now let us see how we begin with a recruit when we take him into the barrack-yard. The first time we move him about we always put him in order with intervals, and we practise him in marching about the yard with the intervals, making him keep his proper distance from the man on his right—if it is by the right, and from the man on his left, if it is by the left. We do that, I suppose, in order better to observe his movements, but at all events we begin operations by making him move with an interval from the man next him, and we do succeed in obtaining accurate movement with interval. Under the conditions of modern warfare for what purpose do we then change our mode and teach him to move touching the elbow of another man? I think it is inconceivable that men can be in any circumstances *where they are to move* in which there is the least reason why they should touch one another at all. The thing you want now, whether your soldier is ill or well trained, is for him to be able to cover with considerable speed a distance of a mile and a half, and you must leave every man's body so free that his action in covering that distance shall be a natural and not an artificial one. Now having got your recruit and begun to drill him in an order with an interval, you still put him afterwards into rank with touch. We have made some progress in giving a man liberty to move naturally. Forty or fifty years ago he was only allowed 20 inches in the ranks, he was afterwards allowed 22 inches, and now we allow him 24 inches. But what do we do? We drill him about in those 24 inches for half an hour or an hour, and then we suddenly tell him we are going to do the business of attack! and what do we tell him then? That he is to have touch no longer, even while he is standing in the ranks, but is to occupy 30 inches of front. Therefore the moment you suggest to the soldier that he is going in for business you at once practically confess to him that what you have told him about rubbing elbows and keeping his eyes fixed to the front has nothing to do with the business in which he is to be really engaged. Again, I beg to be understood that in speaking against touch I say nothing against steady drill—quite the contrary; but I say that, as in former days, the spirit of the combat was consistent with and made touch a necessity; the spirit of the combat has now absolutely departed from that arrangement—of the men standing by their elbows touching—and has entirely gone over to that part of the soldier's work which is done without touch; therefore I say as the spirit of the combat is out of that touch style altogether, let us get rid of it altogether, and let all the training we put our men to be a training in which our constant aim shall be steady drill, but a steady drill which shall train them thoroughly to that they have to do in modern warfare, namely, to move with an interval between them. A great part of our drill has been carried on not realizing that this change has taken place, and therefore our two classes of drill come to be absolutely separate things. That should not be so. I rather think the sound principle of drill would be to a constant transition in the course of the same drill from strict drill—that is, work done with the most absolute regularity that can be got—dressing, and everything of the kind—to the action drill, in which you do not study dressing, but endeavour to work according to the circumstances of the ground, and to work with greater freedom under the control and direction as distinct from the word of command of the Officers. It is the wearisomeness of the long hour, perpetually doing things in a stiff formation, which is unsuitable to modern warfare; that is the objection to our general parade drill; whereas if the parade and the practical were, so to speak, interspersed one with the other, using words of caution, indicate the transition from one to the other—giving the word "Action Drill," and then for a quarter of an hour going on without any attention to dressing, points, &c., but rather pointing out how inaccuracies have arisen, and the way in which they are to be avoided in the future; then giving the caution—"Parade Drill," and moving your men about for another quarter of an hour, with dressing, points, and every minuteness and strictness of form you please—would not this be an enormous improvement? But the things in which extra smartness should be exacted should be restricted. I happen at present to be living where

I have a view of one of our barrack-yards. Now I think that we have gone too far in the matter of looking for smartness in things to which it should not apply. I saw this morning a whole battalion engaged a whole half hour in listening to the words—"Stand at ease," and "As you were." I do not mind hearing the words "Stand at ease." I think if they were used oftener during drill, and really meant what they express, it would be an improvement. To a lady who had never seen military parade, the words "Stand at ease" would at once suggest that the people addressed were to be allowed a little freedom and relaxation, but instead of that, so determined were our forefathers that everything that was done by a soldier should be as stiff and wooden as possible, that the "Stand at ease" has come to be a part of our exercise in which we do not cause the men to stand at ease, on the contrary, put them in a fixed position, and have had to invent another word, "Stand easy," in order to give the relaxation which the words stand at ease would seem to imply.[1]

The CHAIRMAN: Will you allow me to remind you of the rule of this Institution? I am sorry to say you have already considerably exceeded your time. What you have been telling us is very interesting, but there are a good many other gentlemen who wish to speak.

Colonel the Hon. PAUL METHUEN, C.B. (Scots Guards): I speak, Sir, as one neither of the old school nor of the new, but if there is one branch of our forces which will suffer by Officers in the regular Army speaking out too openly and freely about what they consider now to be necessary, namely, "loose drill," to the detriment to a great extent of steady drill, I think that branch of our forces will be the Volunteers. I am not one of those who are always anxious to quote the armies that we should look upon as a pattern, and deservedly, but at any rate I know Sir Lumley Graham will agree with me, that if we are to look at any army for what is good in matters of drill, it is the German Army; and believe me, good as they may be at their loose drill, there is no army which pays so much attention to steady drill. If, as a fencer, I think of the trouble that I take with my fencing, and think how very few of the complicated movements I learn in my lessons I am likely to put into practice, still I feel certain that the more trouble I take with my lesson, the more trouble I take to make myself a thoroughly steady close fencer, the better it will be for me when I fence. So it is with drill. I feel quite convinced that when you think of the number of hours that a battalion is drilled in the German Army, and of the comparatively few hours we drill in our English Army, seeing that we have our men at least three years, and they have their men at most three years—surely we are not expecting our men to learn too much, when we say that they must be able to do their steady drill, and also be able to do their loose drill. But our present difficulty is, and it always has been so, is this—our recruits do not come together at the same time of the year. In the German Army you have a regular routine. They join in the middle of October. You hand the men over to your sergeant, your sergeant to the Lieutenant, the Lieutenant to the Captain, the Captain to the Colonel of the battalion, the Colonel of the battalion to the Colonel of the regiment; then the Brigadier takes them, then the General of the Division. Then comes loose drill. Now observe, there has not been one atom of loose drill mixed up with the steady drill. The men from October to May have received instruction in steady drill. In May the Captain of the company takes his men in hand, and here is what I urge very strongly, namely, that if you choose to have your field training for a battalion all together, for mercy's sake be careful the

[1] Had I not been most properly stopped for trespassing the rule as to time, what I wished to say would have prevented my giving a false impression, which my friend Colonel Trotter said good-naturedly he was sure I did not mean to give. I had no intention of suggesting that the Guards took a long time to learn the "Stand at ease," but only of indicating that the original intention of these words had been lost in the effort to make *everything* like clockwork, and that the Guards' drill-sergeants in setting up drill, had to struggle as hard at "one," "two" at the "stand at ease," as if it had been an important order.—J. H. A. M.

Commanding Officer and the Adjutant do not take away the company from the Captain. There is the secret. From the beginning of May until the beginning of August, you can give your Captain his company, and you say as Commanding Officer, "You are responsible that these men learn their loose drill, that they learn outpost duty, that they know all the varied work that will take place in the manœuvres, and if I find any company of any battalion not thoroughly well up in this work during manœuvre time, I shall take remarkably good care that you, the Captain of the company, suffer for it." If you want all your units of battalions to be thoroughly good and efficient, that is the system and no other. In Germany after the manœuvre month of August and September, the soldiers of the third year return to their homes. There you have a thoroughly clear system, you do not have that at Aldershot. Company training is knocked on the head for a march past; by all means have your march past at the proper time, but do not let us in the middle of the training of a Division, brigade, company, or battalion, all of a sudden have to knock the whole system on the head, in order to have two or three days' practice for marching past, preparatory to some review, inspection, or large field-day. I thoroughly agree with Lord Chelmsford that every good battalion ought to march past. I think that any battalion ought to be able to do the steady drill and march past, and also ought to be able to do loose drill without the slightest trouble. I think one should not interfere with the other, but I do most cordially hope that Volunteers, who have hard enough work, goodness knows, to turn out their men as well as they do, will think most earnestly before ever they consider that loose drill is to take the place of steady drill. I think if we can get our Volunteers and Militia to do their steady drill well, we shall have done uncommonly well.

The CHAIRMAN: I should like to hear the opinions of any working regimental Officer present.

Major FAWKES, Royal Irish Fusiliers: I have only one suggestion to make, and that is that in garrison towns like Portsmouth, where there are companies of two or three different regiments struck off duty for instruction at the same time, they might combine for manœuvring, especially in the latter part of the course. I tried this myself at Portsmouth one year and it answered very well, and gave an interest to the men which would otherwise have been wanting. Failing this, which perhaps could not always be carried out, and in places where there is only one kept, two companies ought to be exercised together *at least*. Major Barker truly says, it is often necessary to manœuvre one half-company against the other, which is useless for instruction. I throw this out merely as a suggestion that occurs to me.

Captain H. C. BOYES (London Rifle Brigade): May I be permitted as a Volunteer Officer to make just one remark with reference to what Colonel Paul Methuen has just said, when he asked us to confine our attention to steady drill? In saying that it appears to me that he has by no means contradicted what my friend Colonel Macdonald has been urging, for I distinctly understood Colonel Macdonald to say that there was no difficulty whatever about having steady drill, but steady drill without touch. It appears to me that that is the whole matter at issue—can we or can we not do loose order drill steadily? If Colonel Methuen, or any other practical soldier, says that we cannot, then we must take into consideration the necessity of going on with drill with touch, but speaking with considerable experience, extending over 23 years as a Volunteer, I maintain that it is possible, especially with such men as we have in the ranks of the Volunteers, to have a thoroughly steady drill without touch. I will yield to no man in my belief in the necessity for steady drill; I am also certain it is necessary that drill should be drilled into the men; men in the ranks must be made to a great extent to drill like machines, they will not lose the necessary intelligence for field manœuvres, but will be all the better for it. But what I want to know is this—why is it impossible to drill them like machines in loose formation, instead of in close formation?

Colonel TROTTER, Grenadier Guards: My friend Colonel Macdonald said, I believe, that it took the Guards half an hour to stand easy. I know he did not mean it. At the same time I must remark that I believe the Guards are known to practise steady drill more than any regiment in the Service. I am told practice is better than theory. Now at the Battle of Abu Klea the Guards Camel Corps were certainly in close order, when they stood extremely steady; perhaps if they had not stood quite so

steady the Camel Corps would not have returned to tell the tale. I certainly advocate steady drill as well as open order drill, but I think we must begin with steady drill first, and practise the open order drill afterwards.

Mr. GRAHAM WILMOT-BROOKE, 2nd V.B. The Queen's Own (Royal West Kent) Regiment: With regard to this steady drill with intervals, we had practical experiments of that kind in our battalion in two companies. It was found that the open, or loose drill, as it was generally practised in Volunteer battalions, certainly did unsteady the men, and the men who were very steady in close order were very unsteady the moment loose order began. We therefore tried drilling in a steady manner with accurately kept intervals, and the result was that the drill in extended order in attack formation really became as steady as the ordinary close order drill by touch. The men were drilled in a large drill hall, with intervals very accurately kept, and they soon marched as carefully with intervals, and by eye, as they had before done by touch. The difference in the fire discipline, and everything connected with attack formation, and moving in extended order, was very marked indeed. I am sure there must be a great deal in this system of drill capable of development.

Captain TULLY, late 28th Middlesex Rifle Volunteers: It is with a little diffidence that I rise to say anything, because the subject brought forward in the lecture has been almost fully covered by the various speakers, and I take it for granted that unless something fresh may be considered, someone more experienced than myself in these subjects had better address the meeting. I wish, however, to mention one point, as to which perhaps I have a special knowledge, and also to point out something that struck me in the course of the discussion, and with regard to shooting. Colonel Evelyn said he considered steady drill to be the first necessity of shooting. We shall later on in the session have a lecture here on the new military arm, and that arm will perhaps be fully discussed. I should otherwise, perhaps, have gone into more details, giving my views about the Martini-Henry, and spoken of the various points connected with shooting, because I think they would bear very materially on the question at issue. My deliberate opinion is that it is not possible to teach the soldier to shoot accurately with any amount of drill with the present Martini-Henry rifle. I remember very well my first experiment with a herd of antelopes. These deer were the first living objects I had ever shot at. I took an accurate position, and sighted the rifle very carefully; I missed every shot for the first ten shots, although the deer ran straight at me, and passed by me 70 yards off. That is my personal experience, since which I have been very dubious about the advantage of theoretical musketry instruction. What we want is a rifle which can be readily raised to the shoulder. If a man is to be practised continually at short ranges he must have an unlimited supply of ammunition, and he must be taught not to bring the whole of his muzzle and the whole of the foresight into the line of sight, and to do that it is absolutely necessary that the stock should be brought rapidly to the shoulder. Every Officer who has shot big game or birds will know that he has his gun fitted to his shoulder, just as his clothes are fitted to it; the stock of the rifle must be made so that it fits him, then he raises his gun up and hits the bird. But let any Officer in the Army take the Henry-Martini rifle, with a hair-trigger if he likes, and see how long it will take him to "draw a bead" on any bird or animal of any kind. I believe that, take it altogether, the lecturer and the speakers are very much in accord, and also that Colonel Macdonald and Colonel Methuen are very much in accord. I apprehend Colonel Macdonald to mean that it takes more continuous practice to make a man drill well in loose order than in close order, and that a man must be a far better drill to drill in loose order than to keep his "touch." I apprehend the lecturer to be desirous of knocking out a number of useless formations, which will give more time to practise steady drill, and more time to practise those items of loose drill which are absolutely essential to the modern order of battle. It appears to me, therefore, that there is not much issue joined, either between the various speakers or the lecturer, and I confess that with my friend Colonel Macdonald, and Captain Boyes, I have an extreme belief in the value of loose drill as interpreted by those two Officers, and I believe it will make the soldier much better at steady drill if you put him back to it, than if you practise him at steady drill and then only for a change rush him into a loose formation.

The CHAIRMAN: I have been very much interested by this lecture. The chief point of it, and a very valuable point I think, is that Major Barker seeks (what we all wish, no doubt) to make the Army a really efficient body for war purposes. No doubt that was at one time rather left out of sight in this country. During the long European peace the Army at home had become rather a parade army, though it had during that very period a lot of fighting to do in out-of-the-way places; but things are different now, though some relics of these days of torpor still remain. Major Barker's suggestions, or the greater part of them, are very valuable towards making the Army even still more of a fighting army than it is. He spoke of the small number of men available for drill in battalions on the reduced establishment, that is to say, the great majority of the battalions at home. The different classes of remedies that he has proposed all seem to me to be good in their way. First of all, the extension of service for men in India; that will tend indirectly to produce the result he wishes, namely, to give us more men for training at home, and that I hope is a change that will be carried out. It is an idea that seems to be generally approved of. Then as to the reduction of guards and orderlies. Really I think there is a superstition about guards. It is thought to be necessary to have a guard here, there, and everywhere, and as the lecturer and others have said, in many cases flying sentries, or small patrols, would do the work much better, with less detriment to the men and with a great economy of labour. A very small number of men would then be kept away from drill by duties of this description. Then as to orderlies; the amount of orderlies that there used to be, and I believe still are taken from corps in garrison towns and camps, is something distressing to Commanding Officers who are always called upon to send their best men to act in this capacity, and these are temporarily lost to them. This question was gone into some years ago at Berlin. They wanted as many men as possible in the German Army for training, and they established a system of communication by telephones or telegraph between the different barracks and military departments, so that almost all the work of messengers was done in that way, at a great economy of labour.

Colonel METHUEN: You do not see one orderly in the War Office there.

The CHAIRMAN: It is done by a system of electric communication.

Colonel METHUEN: There are one or two old soldiers there.

The CHAIRMAN: The German authorities understand the necessity of economizing labour as much as possible.

Colonel DAVIES: In the Southern District telephones are used now in all the barracks and forts.

The CHAIRMAN: I hope it has the effect of doing away with a number of orderlies.

Colonel DAVIES: We never send men out as orderlies.

The CHAIRMAN: I see them in London a good deal. You must have a certain number of orderlies in the Staff Offices and departments. I should think that this is an opening to use discharged soldiers for that purpose. A great number of unemployed reserve and discharged soldiers would be very glad to get any work of this sort, and I think you might find a good many men of that class who would be very useful for this purpose. All these things would tend to help Major Barker's object of getting as many men for drill and instruction as possible. With regard to company instruction, I think there is no doubt that it is the foundation of all solid military training, and that Captains should be allowed, as they are in the German Army (as Colonel Methuen pointed out) to have their companies to themselves, without interference for a certain time every year to work them up. Carried still further, Commanding Officers of battalions ought to have their battalions to themselves for a certain time afterwards to work them up, and they should not be constantly interfered with, as they are too often in this country, by General Officers' parades, which interrupt the regular order of regimental training. In the German Army the training of the different units from lowest to highest is carried out in a regular succession, and one of the great wants in our Army is this methodical system of training, carried out in a regular course without interruption. I have always been of opinion, as some of my hearers may know, that we might gain a great deal in every way by adopting the four-company system in our battalion

organizations, and there are a great many arguments to my mind in its favour, which I won't trouble you with now. This is not the time to give them. But there is one argument that applies specially to this question which I may mention, and that is, that by having the battalion divided into four companies instead of into eight, you give the Captain double the number of men to make use of; therefore, when a company is kept off duty for training the Captain will always be sure of having a fair number of men to work with. I think that is one of the many arguments in favour of a system adopted by every army on the Continent; but I am sorry to know that it is distasteful to the higher authorities of our Army, and I will say nothing more about it on this occasion. Within the last two or three years a great impulse has been given to company training, which had before been at a low ebb, many excellent orders on the subject having been issued, but it is difficult to carry out those orders in the great majority of the battalions at home on account of their weakness. If the companies were stronger—as I wish them to be, double their present strength—without increasing the establishment of the Army, it would give much greater facility for carrying out the very excellent orders referred to. I am persuaded that you cannot have a thoroughly efficient infantry regiment unless the companies have complete training by their own company Officers. With regard to the simplification of drill, most people admit that it is advisable. There is a great difference of opinion as to the amount of mere drill that is required; I am one of those who wish for less drill and more instruction. I quite believe that absolute steadiness is required; I would have steadiness not only in the mere drill but in every part of a soldier's training. I have sometimes remarked that when companies extend in skirmishing order it seems to be thought that all steadiness may cease. The men are allowed to play about and laugh. That ought not to be. Soldiers ought to be quite as steady when in extended order as when in close order, and I am persuaded that this is a very great point to insist upon. I am inclined very much to agree with Colonel Macdonald,—whom I was very sorry to interrupt, but it was only in consequence of the pressure of time—I was very much interested by his remarks, the more so because I have just said I am inclined to agree with them. I long ago thought that the system of drilling at intervals (in extended order, in fact) was an excellent one, and that if a soldier were thoroughly, not loosely, trained from the very first to work in extended order he would move much more steadily and efficiently before the enemy. There were other gentlemen who supported that view also, but I am aware that there is a very strong feeling against it. I am afraid I shall be thought a great revolutionist in the Army generally for advocating such a thing, and I am bound to say that the German Army, which we look upon as the first army of the day, in war is very strict indeed about these steady movements. When I was at Versailles in the middle of the siege, I saw the German troops off duty, those who were not in the trenches, actually drilling at what we call irreverently the "goose step," and at what to my mind is very absurd, namely, their prancing parade march, just as if they had been in garrison at home. The snow was on the ground, and I saw them all out by squads at the stiff drill. The next day they would probably be in the trenches, either fighting or prepared to fight. So that it is only fair to bear in mind that German soldiers, who are certainly the most successful of the day, lay a very great stress upon this stiff drill, and it is stiff drill with a vengeance in the preparatory stage. Still, for all this, I should like to see the system advocated by Colonel Macdonald, and I may add by myself years ago, tried fairly. I believe myself that it would be successful. I will not go into any of the points the lecturer spoke about as to the sections in the "Field Exercise" that he would recommend to be abolished or else modified. I think that is a question in which the able Officer now Adjutant-General of the Army quite sympathizes with Major Barker, as I have heard him in this theatre several times express very strongly his opinion that there was a great deal of unpractical matter in the "Field Exercise" book, even since its frequent amendments, which ought to be taken out of it, and I think we may be quite sure that that subject will be looked into carefully and speedily. It will, I hope, be submitted to a Committee of experienced Officers, amongst whom I think there ought to be a large infusion of regimental Officers. With regard to musketry instruction, which is also now under consideration, I always was of opinion when I

was a regimental Officer that the musketry instructor was a person who ought to be done away with, and I welcomed the change when he was done away with, because I always thought he was a thorn in the side of a good Captain, and that he was a dangerous encouragement to a less good Captain to neglect his work, or slur over it. It is very difficult to prevent an official of that sort from interfering with the instruction of companies. But it is possible that there may be room for a musketry instructor in a battalion for the purpose of doing all that sort of work alluded to by the lecturer which is beyond the province of the company Officer; but, if the musketry instructor be re-established, all I hope is that he will be strictly forbidden to interfere in any way with the company musketry instruction, or even to be present at it. The most important branch of musketry instruction has been carried out very little in our Army until quite of late years, and that is what we call field firing, what the Germans call "war firing." That is the most important practice of all, and it is only of late years that we have taken to it at all, and even now it is not carried out very completely. It is a most important practice, because it not only teaches men to fire under the conditions most nearly approaching to those of active service, but it also teaches that most important thing of all, fire discipline, and teaches Officers and non-commissioned officers in the noise and excitement of action to handle men, and how and when to employ all the different sorts of firing that should be resorted to under various circumstances, therefore it is practically most important both to men and Officers, and I think the want of that training is the chief reason of the comparative inefficiency of our firing since our troops have been armed with the breech-loader. There is one great difficulty in carrying out a system of field firing in this country, and that is the want of proper ranges. I was happy to hear from Colonel Moncrieff that with regard to the ranges for ordinary target practice that difficulty at least is in a way to be overcome, but that does not do away with the difficulty for field firing. You want a very extensive piece of ground for that purpose, and there are very few places in this country where we have ranges fit for field firing. It would be an advantage if the Government would buy some pieces of ground on the moors in the north of England and in the midland counties, so as to give us one or more other Aldershots, not for troops to be moved out of the towns to be constantly quartered there, as the lecturer suggests, but to be used at certain seasons for this very purpose of field firing, and for other training. I know there is very great difficulty, that a great deal of money must be spent to give us proper ranges, but I do not think that it is money that will be refused by the nation if we can bring it home to our fellow citizens that it is bad and dangerous economy in these days to deny our infantry of the standing Army, Militia, and Volunteer force the means of making themselves thoroughly acquainted with the use of their weapons. The concluding remarks of the lecturer I thought very good, they quite chime in with what I feel myself with regard to General Officers' inspections, and Lord Chelmsford, who no doubt has inspected a good many regiments, quite agreed with the lecturer that the system of inspection as laid down by authority was not what it should be. As long as you have a system of inspection which goes very little beyond the merely ornamental part of military training you won't have the more important practical part thoroughly attended to. The lecturer alluded to some remarks made by Prince Hohenlohe, a very distinguished Officer in the German Army, on that very subject. He published a book upon infantry, of which I translated certain portions, which appeared in our Journal. He well sums up this question of inspections by saying, "A corps will certainly be trained so as to fit it for the sort of inspection which it will have to undergo." This is certainly the case, and if you want an army fit for war, make your inspections so as to go carefully into all that is important in warfare; if you want an army for show, go in merely for marching past and such like. I think that the British nation will prefer the former sort of army, and I have no doubt that with the material which we have in men and Officers we can obtain an army second to none in warlike efficiency if we go the right way to work. In the discussion there was a good deal said about the comparative merits of loose and steady drill. I think those terms are misapplied, "loose" and "steady." I do not think there ought to be such a thing as "loose" drill at all, all drill ought to be steady. But I think the lecturer was misunderstood by some of the speakers. I did not understand him for a

moment to mean that steady drill was to be neglected, he spoke of that as the means to the end. Steady drill is the means to arrive at the end which is warlike efficiency, but you may sacrifice the end to the means, and that is what we have done, in fact, a great deal in bygone times, and that is what the lecturer wishes to avoid, but he will speak for himself. I will not occupy your time further, but will ask the lecturer to reply to the remarks that have been made by the various speakers.

Major Barker: I was very glad to hear the Chairman, and also Captain Tully, recognize that I did not belong to the school of those who wanted to have no drill at all. I think if anyone takes the trouble to read my paper carefully, he will see that I do not advocate less drill, but more drill. I am certainly an advocate of more drill than is actually carried on in the British Army at present, and as a means to that end I want to get all the men I can, and then to drill them as often as I can. Lord Chelmsford in his remarks said that we used to have more steady drill in line, and that we generally beat the French in that formation. That was all well and good as long as the line was the fighting formation. Of course, the more we had of advance in line and shoulder to shoulder the better, but now we do not fight in that formation; that is the question that goes to the very root of the matter. We fight in extended order, therefore I say, have as much extended order as possible. Of course you must have close drill to a certain extent, but have a great deal more drill in extended order than we have now. Colonel Davies says we must remember we have a great deal of savage fighting to do. So we have; but then again I wish to remark that it is not upon fighting savages that our honour and existence as a great nation will ever depend. Our honour and existence as a great nation may depend some day on the way in which we fight, and that fighting will not be in close order. I must say my sympathies are with Colonel Macdonald, but it required a certain amount of moral courage for an Officer in my position to come forward with a lot of revolutionary proposals, and I must say I was afraid to touch on that question. I did not like putting my views in opposition to those of a large number of very experienced Officers. Then again, it is an excellent thing for a Captain to have his men to himself. I wish he could have them a great deal more to himself; but what is the good of fifteen files to a Captain, what can he do? He can only do very elementary things. How can you do outposts with pickets, and sentries, and supports, and reserves, and all the rest of it, with fifteen files? How can you manœuvre seven and a half files against the other seven and a half? It cannot be done; the whole thing is impossible. And lastly, as regards the musketry instruction. I do not want to see the musketry instructor with any one's company. I would not allow him within half a mile of a company, but I do want to see a musketry instructor looking after recruits, and ranges, and all that sort of thing. It is no doubt good for young Officers to make them put through squads of recruits; it is good for the Officers, but it is not good for the recruits. I was at Hythe two years ago, and I am sorry to say I have forgotten a good deal of what I learnt there already. It is impossible to do your work thoroughly without doing it constantly. A man just told off to take a squad of recruits and put them through musketry forgets a lot of the little things he learnt at Hythe: he is more or less inexperienced, and cannot do it so well as a man who is always doing it. It is just the same as the question of the corporal instructor of recruits. A corporal instructor can do it better than an Officer, because he is always doing it. In the same way a musketry instructor, or an Assistant Adjutant for musketry, can put recruits through musketry a great deal better than an Officer who is just told off for the duty. I am sure I am extremely flattered at the way in which my lecture has been received. I did not expect very much sympathy, I expected, on the other hand, a good deal of opposition, and it has, on the whole, been quite the contrary. I will conclude by thanking you for your kindness.

The Chairman: I am sure you will allow me to present, in your name, a vote of thanks to the lecturer for his very interesting and able lecture, and to the various gentlemen who have joined in the discussion.

Friday, February 19, 1886.

ADMIRAL THE RIGHT HON. SIR A. COOPER KEY, G.C.B., F.R.S., Vice-President, in the Chair.

NAVAL TACTICS.

By Rear-Admiral the Hon. EDMUND R. FREMANTLE, C.B., C.M.G.

THE subject of my lecture this afternoon, although it has a short name, which I have not attempted to expand as I was desirous of having a free hand in dealing with it, is like the grain of mustard seed of Scripture, embracing in its comprehensive nature something at least of all those subjects of interest to the Navy which we are accustomed to hear discussed in this theatre. It is impossible to touch it without trenching on questions on which opinions will naturally differ, and I feel guilty of some temerity in attempting the task, daily becoming more difficult, of differentiating the values of the various arms and scientific appliances in use in naval warfare. It is however one which has always had a great fascination for me, both as a naval Officer and as a student of naval history.

Every naval Officer may hope or at least dream of crowning his professional career by commanding a British Fleet in action, and how that action should be conducted, when the time arrives or may arrive that the honour and perhaps the existence of his country is entrusted to his hands, is a subject of unfailing interest and study. The difficulties of the question to which I have alluded are no doubt great, but I cannot admit that they are insuperable, or that we can put off their consideration to a certainly not more propitious time, when the "dogs of war" have been let slip, and some action must perforce be taken.

I am at a loss to know whether to express my regret or my satisfaction at the meagre bill of fare which is at our disposal to enable us to draw from modern instances some lessons as to the value of the tools which we shall have to use. But while we may regret from the tactician's point of view that we have no recent examples of naval actions to guide us, let us not forget that glorious naval history of the past which is pregnant with lessons to those who read it aright as to those main principles underlying all warfare, which enabled our Nelsons and Rodneys to lead British Fleets to victory.

I should think it unnecessary to allude to this, but that it has not been the custom to make a serious study of our naval actions, and I

have observed that Professor Laughton's eloquent advocacy and illustration of the principles of the naval tactics of the past have been scarcely sufficiently appreciated by our young Officers.

But I am content to leave this part of my subject to Mr. Laughton, merely adding that I agree with M. Gougeard, the French Minister of Marine under Gambetta, who says that[1] "Retrospective studies are sterile only for superficial minds, for those who neither know how to understand nor to look deeply into things."

Leaving then the temptation to trace the gradual changes of tactics which necessarily followed on the improvement and development of ships' arms and modes of propulsion, I will at once plunge into the question of modern naval armaments, but, before doing so, let me draw attention to the fact that though what I have just stated is a truism as regards the past, there are many who are at least very reluctant to accept it when practically applied to the present, and who find it hard to realize the stubborn fact that changes in tactics must follow on every important improvement in naval armaments.

Six years ago, in an essay for which I had the honour of receiving the Gold Medal of this Institution, I endeavoured to deal with this subject, and I trust that I shall not be considered egotistical in referring to it, as to me at least it affords a convenient starting point for recent changes. Then as now we had the gun, the ram, and the torpedo as weapons of offence, we had ironclads and a few torpedo-vessels, which were rather experimental craft than as yet adopted in the Navy.

The "Vesuvius" had indeed proved some years previously that the Whitehead could be made a formidable weapon under certain circumstances, the "Hecla" was in commission as a torpedo depôt ship, the "Lightning" had recently proved the hitherto unsuspected capabilities for speed of small steel vessels, which promised to add such an enormous power to the torpedo attack, and our ships in the Mediterranean had been armed with the Whitehead torpedo.

On the other hand, the "Polyphemus" was still on the stocks, the outrigger torpedo was in more general use than the Whitehead, the pattern of the latter, with which our ships were in most cases armed, were the fat 16-in. specimens which had a speed of $12\frac{1}{2}$ knots for some 300 yards, and which had the incidental advantage of having so much buoyancy that though they frequently skimmed the surface of the water they were seldom lost, the Whitehead was discharged from ships by the obsolete impulse tube, and the dropping gear was the mode of discharge generally adopted by 2nd class torpedo-boats, even those carried by H.M.S. "Hecla."

It is true that some foreign nations, the Austrians, and especially the Russians, were in advance of us in torpedo science. The latter had developed the torpedo attack in their war against the Turks, and in preparation for war with this country. They had already in 1880 adopted the torpedo-gun, and had actually fired Whiteheads against the Turkish ships at Batoum, while their torpedo-boats, mostly 2nd

[1] "La Marine de Guerre," 1884.

class boats built in England, in 1879 numbered over 100, but even the Russians had not been able to score any success with this weapon, the two Turkish gunboats sunk by them in the Danube having fallen victims to the outrigger torpedo, as Admiral Hobart Pacha tells us,[1] "through keeping a bad look-out."

Such was the position of the torpedo six years ago. To ground-mines and the outrigger I do not refer, they had won their spurs in the American War, but I think I was justified in speaking of the Whitehead at that time as "still in its infancy."

This description of the Whitehead torpedo, whether accurate or not at the time referred to, is certainly inapplicable to the robust manhood it has now reached; true it is a complicated weapon which scores not a few failures, as those who have had practical experience of it in sea-going ships must admit, in spite of the somewhat rose-coloured returns of successful shots which are shown by official reports, but its power, its range, its method of discharge, its reliability, have all increased, and are still increasing. We must all admit the torpedo described by Commander Gallwey, in this Institution last March, with its speed of 24 knots for 600 yards, and its charge of 70 lbs. of guncotton, to be a most formidable weapon, and his assurance that the later patterns can be supplied fully adjusted and ready for use is not the least of the practical improvements recently made.

I have dwelt long on the Whitehead, as it is the automobile torpedo, and especially the Whitehead which threatens to revolutionize maritime warfare. The torpedo was born of chemical inventions in explosives, but this alone did not do much towards rendering it an effective naval weapon till mobility was supplied by machinery and the steel torpedo-boat.

The torpedo-boat proper needs no description here, nor have I space for technical details of the various classes, but the following table, which is I believe fairly correct, is interesting as showing that fleets of torpedo-boats are already in existence, and that in dealing with naval tactics they must be considered as potent factors which will have to be reckoned with.

Number of Torpedo-boats Built and Building up to January, 1886.

	1st Class.	2nd Class.	3rd Class.	Total.
Great Britain	61	19	50	130
France	57	41	9	107
Germany	59	5	3	67
Russia	26	92	20	138
Italy	47	5	18	70
Turkey	4	—	1	5
Austria	30	7	1	38

[1] "Blackwood's Magazine," June, 1885.

The classification of the torpedo-boats here adopted is as follows—

1st class.—Over 100 feet in length.
2nd class.—Over 70 feet, and under 100 feet.
3rd class.—Under 70 feet.

In Germany, money has been granted for 105 boats, to be eventually increased to 150. Four of the Russian boats are 152 feet long, and nine of the Italian boats are 148 feet.

I have taken the torpedo-boat proper and torpedo itself first, as it is the weapon in which there has been most change recently, but the "Polyphemus," the "Scouts" building, the "Grasshopper" class of torpedo-catchers in our own Navy, and the "Bombe" class building in France are all developments of the torpedo and must be shortly dealt with.

The "Polyphemus" is an overgrown torpedo-ship or ram of special value under exceptional circumstances, but as I think too large and expensive a vessel to be often repeated, especially if the ram is to be made a secondary consideration. The new "Torpedo Ram," or improved "Polyphemus," of 3,220 tons, voted in this year's Estimates, has not I believe been laid down hitherto, and does not appear in the January Navy List. We have seven torpedo-ships of the "Scout" class, 1,400 to 1,600 tons, built or building, which will no doubt prove useful vessels as cruizers and look-out ships, but they are 225 feet long, and draw 14 feet water, so that they are too large, too costly, and offer too good a mark for the Whitehead to be considered simply as torpedo-catchers.

Of these latter proper, or "Grasshopper" class of 450 tons, 200 feet long, and drawing 8 feet water, we have four building at present, though it is intended I believe to order more shortly. They are expected to go 19 knots under ordinary circumstances, and promise to be fair specimens of the "torpedo-catchers and destroyers" which Sir E. Reed and Sir N. Barnaby have agreed in advocating.

In the French Navy, they had already building eight *torpilleurs avisos* of the "Bombe" class, of 318 tons, and intended for 18 knots speed, when Commander Gallwey gave his lecture here last year, yet it was not till quite recently that our "Grasshoppers" were laid down, and as they are conspicuous by their absence in the Navy Estimates, we may consider that the late Board considered them as urgently necessary. The French have also four torpedo-vessels building of a larger class. It is probable that with Admiral Aube's, the new French Minister of Marine, well-known partiality for the torpedo, we shall have our neighbours making a fresh start in building torpedo-vessels and boats at the expense of ironclads.

These novel vessels will in my opinion act a very important part in future naval actions and operations, so that I have alluded to them at some length, but I come now to the ironclads. Our ironclads have not changed materially lately, and the special points in their structure which have evoked criticism have been ably dealt with by Sir E. Reed and Captain Fitzgerald in this theatre; I am also anxious to confine myself to questions directly connected with tactics. As

bearing upon this the armament of our ironclads is important, and considerable changes and modifications in armament have taken place, and are daily being developed from the advance of the torpedo attack. The torpedo attack was favoured by the armament of the ironclad, which consisted ten years ago solely of heavy armour-piercing guns. The "Thunderer," for instance, even six years ago carried two 38-ton and two 35-ton guns in her turrets, but if we except a Gatling in the top she had positively no other defence except small-arm fire. This was evidently a dangerous state of things which had never been accepted in foreign navies, but it was not till December, 1879, that the "Invincible" took out the first six Nordenfelt guns supplied to the Mediterranean. So rapid has the development of the anti-torpedo armament of our ships been lately, that the Nordenfelt 1-inch machine-gun hitherto in use in our Navy is already practically obsolete, and is being replaced by the 6-pr. Nordenfelt or Hotchkiss gun, and the 3-pr. shell-firing Hotchkiss or Maxim.

The armament intended for our new ships "Nile" and "Trafalgar," is, we are told, in addition to the two armour-piercing guns and eight smaller guns, probably 6½ tons, to consist of eight 6-pr. quick-firing guns, and ten 3-pr. Maxim machine-guns, with probably four Gardners.

This is a formidable array of what I have heard irreverently called "gingals," but a ship thus defended is not the easy prey in the day-time at least to even a score of torpedo-boats which a "Thunderer" or "Dreadnought" would have been only six years since.

The 6-pr. Nordenfelt firing shell at the rate of ten per minute has already been described in this theatre, but the 3-pr. Maxim[1] which is I understand to be adopted in the Navy is worth more than passing notice.

Through the courtesy of the inventor I was allowed to inspect this wonderful little machine-gun in Hatton Garden a few days ago, and the following description of it may be of interest.

3-pr. shell-firing Maxim gun, single-barrelled, about 8 feet long; weight, 750 lbs.; charge of powder, 1 lb. 12 oz.; fires 60 shot per minute; cartridge box attached to standard holds 40 shell; muzzle velocity 2,000 feet.

Supposed to be good against torpedo-boats, 3,000 to 4,000 yards.

It is self-loading by the recoil as with the small 0·45 Maxim shown at the Inventions Exhibition last year, but in accordance with Admiralty requirement it fires by a pistol trigger, though it can be continuously fired by keeping a constant pressure on the trigger or button. It has a shoulder-piece and is elevated and trained in the same manner as the Hotchkiss, but the shoulder-piece is attached to a case, within which the trunnions work on a slide, the recoil being taken up by a hydraulic buffer.

I have stated that I am not inclined to go into the vexed questions connected with the structure of our ironclads, but there is one point of great tactical importance which I have not seen referred to. I

[1] I am told that this gun is only on trial at present, but I believe it will be adopted if it proves not to jamb or otherwise fail under the tests.

allude to the masking of the guns in the turrets of those ironclads which have them in échelon by the superstructure, which is a serious drawback to their fighting value. That a turret should have as nearly as possible an all-round fire used to be an axiom, and this desideratum has been obtained in our older turret ships "Dreadnought," "Thunderer," and "Devastation," but while the "Dreadnought's" four guns can be fired through an arc of 240° out of 360°, the "Inflexible" I believe can only fire her four for 96°. As I have no reason to believe that the "Inflexible" is in this respect inferior to the other modern double turret-ships ("Ajax," "Agamemnon," "Colossus," and "Edinburgh"), it shows the terrible price which practical fighting efficiency has been forced to pay to what I venture to call the "fad" of a nominal end-on fire.

Whilst on the subject of fighting efficiency and gun-fire, I wish that more attention were paid to the all-important question of smoke. Smoke on a calm day will shroud ships in action in an impenetrable veil which will give torpedo-boats opportunities for successful attack in comparative safety, while a dark cloud of smoke may make the "best laid plans" of Admirals to "gang aft agley," yet we know that sportsmen have succeeded in finding a powder which practically has no smoke, and we may hope that improvements in our gunpowder for heavy guns will have the same result in due course. I am told indeed that the brown powder made in Germany, and which we have not hitherto succeeded in making at Waltham Abbey, is practically smokeless, the carbonate of potash of which the smoke is composed dissolving easily in air, while with our ordinary black powder the sulphate of potash is not soluble in air, and must be dispersed by wind. A company has I hear been formed to buy up the German patent and make this powder at Chilworth, and I can only hope that the result may prove as great a success as is anticipated. It is certain that anyone who can invent smokeless coal and smokeless gunpowder will not only do an inestimable service to this country, but will also make his fortune, so I suggest to those overburdened with inventive talents to turn them in this direction.

In referring to the active as opposed to the passive defence of ironclads, mention must be made of the torpedo-boats she should herself carry, for though a fleet of torpedo-boats could always be attached to every fighting squadron, every big ship should be as far as possible self-supporting, and should carry at least two torpedo-boats capable of being dropped easily from the ship even when under weigh.

Here again is a field for mechanical invention, for the present plan of hoisting a flimsy steel boat out by a derrick makes it impossible to get her out or in except under specially favourable circumstances which cannot be expected to be those usually experienced.

It is a question too as to whether our second class steel boats of 62 feet length, which are those usually supplied, should not be replaced by more substantial wooden launches, such as Mr. White's turnabout boats, which would be useful for ordinary ship work, but I would not make any change which would entail a reduction of speed

on the measured mile below 15 knots, as if these boats are to be of service, their speed should not be inferior to that of the ship under favourable circumstances. With reference to the machinery for hoisting and stowing these boats, it has occurred to me that some plan similar to that adopted for paddle-box boats might be adopted, the boat being hoisted by chains and a steam winch, the chains passing through sheaves in davits which should be bent so as to fall inboard, being worked in and out by small spurs. It would be necessary to carry out this idea that the boats should be built with permanent slings as high as the gunwale which would enable the chain slings to be so short as to be easily handled.

I have endeavoured to explain my idea by the accompanying rough sketch, but I do not see much difficulty in carrying it out if the builders of our ships' torpedo-boats will only consider it important to lift the boats by the two ends instead of by the centre. The davits may appear cumbrous, but we must make some sacrifice towards attaining the end in view, namely, to be able to drop torpedo-boats quickly from our ships when necessary.

Let us now look at the passive defence of ironclads against torpedoes which rests mainly on her numerous watertight compartments, coffer-dams, and cell construction, or what Admiral Sir George Elliot refers to as her raft body, and the question arises as to whether such protection can be of any avail against the torpedo. This is a large question, which can only be settled by actual experience in warfare, but it is certain that the last word in this direction has not yet been said, as Sir E. Reed's proposed armour-plated bottom and Admiral Elliot's proposed crinoline shows. It is true that our only experiment against a model of the "Hercules'" bottom showed such a wonderful success for the torpedo, that, as Commander Gallwey told us, the charges of all locomotive torpedoes were reduced to 30 lbs., and that since that time they have been increased to 70 lbs., but we have the following from Commander Bainbridge Hoff, of the United States Navy, in his work on "Modern Naval Tactics," published in 1884, who as an intelligent American naval Officer may undoubtedly be looked upon as not prejudiced in favour of ironclads. "To us it appears as if the coming ship would be, as regards her keel, nearly if not quite torpedo-proof, through numerous watertight compartments, &c." Again, we have a French naval Officer, Lieutenant Weyl, writing only last year,[1] and giving the following account of some recent experiments made by the Italians at Spezia with the view of testing the strength of one of the new ships they were proposing to build, the "Sicilia." Lieutenant Weyl's account is as follows: "They moored in the harbour of Spezia a caisson representing a treble bottom in steel, being a section of one of their ships in project; this caisson, covered with an armoured deck and suitably trimmed, was sunk in such fashion that it was in a similar condition to the under-water portion of a ship to which it had belonged. On a torpedo being shot at this caisson, and exploded, the outer and inner skins were broken, but the third—the interior skin of the vessel—resisted admirably."

[1] "Questions Maritimes." Par Em. Weyl, Lieutenant de Vaisseau en retraite.

He then mentions that these experiments were continued on the same caisson, but with one cell filled with coal, the result being that only the outer skin was broken. M. Weyl remarks that this experience was conclusive, and it is certain that the Italians considered it as a victory for the ship, as orders were at once given to lay down the "Sicilia" and her sister the "Ré Umberto" ironclads.

It is, however, only fair to state that from other sources I have heard a different account of this experiment, which has been kept as secret as possible, this report saying that a section of the "Sicilia" was sunk horizontally at a depth of 9 or 10 fathoms, and 75 lbs. of guncotton exploded on it, the result being that the outer bottom was blown in and the inner somewhat damaged, but that the interior cells filled with small coals resisted. Whether such a trial as this effectually represented the explosion of a Whitehead against the "Sicilia's" bottom may be doubtful, but it is certain that the Italian authorities looked upon the result as a victory for the ship. The necessity for some similar experiments in England is, I am glad to see, at last acknowledged by the Admiralty, as the "Resistance" is to be coated with "cellulose," a fibrous substance said to have a wonderful property of closing up again when a hole is made in it, and torpedoes are to be fired at her, while the protection to be afforded by "coal armour," both above and below water, is also to be tried. It is natural to hope that the result may in this case, too, be a victory for the ship. The experiments will be looked forward to with keen interest, and it is another proof that the last word has not yet been said on the subject of protection against torpedoes.

I have only further to consider the nets now fitted to our ironclads as means of passive resistance against torpedoes. There is a natural inclination to laugh at them as unpractical, they take up room, they are an awkward encumbrance to movement, the Commander finds that they are an interference with royal yard drill, and that they scratch the ship's side, the Staff Commander fears that they will foul the screw, the Dockyard authorities find them a tax upon their ingenuity as well as a source of expense for which they get little immediate return, yet slowly but surely they are being adopted, the difficulties of working them are being overcome, and their importance is being acknowledged. The problem of getting these nets out is being effectively solved in the Mediterranean Fleet under Lord John Hay, who has given much attention to this important question I do not know if the bow and stern defence, several plans for which were being tried a year ago, has been settled, but I know that the broadside defence by nets has been successfully carried out. In the "Dreadnought" we had a broadside defence fitted according to a plan of Staff Commander Miller, and I was able to steam with it at a speed of 8·5 knots without danger, though at that speed the nets undoubtedly "sagged" aft considerably. The plan can scarcely be explained in few words, but I may mention that the ship answered her helm well when using the nets, the loss of speed being only about half a knot, and that when they were once out they could be brailed up and the booms run fore and aft in about one minute, or got out

again equally quickly; also that with the booms fore and aft they could be carried, as indeed they were carried in the "Agamemnon," without material damage in bad weather. M. Gabriel Charmes,[1] indeed, in his enthusiasm for the torpedo, makes very merry over the large masses of ironclads with their crinolines encumbering their every movement, which would make them sure victims for the ram, but as his future fleet is to consist solely of torpedo-boats, lightly armed cruizers, and small gunboats, I do not see where the ram is to come from, and I quote his opinion now as showing the shifts to which extreme advocates of the torpedo are driven.

I have endeavoured to consider the torpedo and the gun as its active opponent, as they exist at present; I have also touched on the ship's structure, on her defence by torpedo hunters, by her own torpedo-boats, and by nets, but there remains the electric light, the proper use of which will be referred to both in treating of foreign and English sham fights and naval manœuvres. I must, however, remark on the great improvements which have recently taken place in the power and efficiency of the electric search lights carried by our ships.

A few years since most even of our ironclads carried a weak electric light, with one or at most two projectors; now not only has the light itself been much improved, but the number of projectors is to be increased to four in each ship.

The proper place for the electric light has also formed the subject of experiment, and I understand that in future it will be placed low down, below the guns if possible, which I believe will be a decided improvement, as hitherto the endeavour has been made to raise the light higher and higher, in the vain endeavour to overlook all obstacles, there being not a very healthy rivalry in most of our ships between the electric light and the standard compass as to which should be nearest the maintop. Something more is required to enable the carbons to be automatically adjusted, and if the projector could be worked at a distance from the light the boat or object lighted up would be followed more easily. I think, too, that all our ships, except perhaps gunboats, should be fitted with the electric light, and that at least one steamboat in each ship should carry the electric light as is the case in the Russian and other navies. When and how the electric light should be used is an interesting question, and one which I had some opportunities of studying whilst in command of the "Dreadnought," but I will only say here that the blinding effect of the light when turned upon a boat at night makes it quite impossible for the Officer in command to appreciate distances, or to see what he is doing, which is a strong argument in favour of using the light.

There are other questions intimately connected with tactics to which I have only time to allude, there is the best size for our fighting ships and the use of the ram. On the first point I am daily becoming more and more convinced of the importance of speed. If, as I think, the improvements of torpedoes have brought the gun and

[1] "Les Torpilleurs autonomes et l'Avenir de la Marine," par M. Gabriel Charmes, 1885.

manœuvring into a more prominent position, I hold that speed must remain a primary factor to be considered, for manœuvring power in the open sea means speed in most instances. I cannot, therefore, agree with Sir George Elliot and others who would, in order to keep fighting ships as small as possible, sacrifice speed.

From this point of view I do not see how the size of battle ships is to be limited if the ships are required at all, and at all events I am on the side of the big ship, as Moreau was on side of the big battalions. I deny the possibility of reducing this question to a pecuniary standard; if the big ship is to be complete in herself, and to perform the duties demanded of a line-of-battle ship in old days, she must have size or she will display decided weak points in one direction or another. That special vessels of various classes intended either for speedy torpedo-vessels, heavy battery ships of slow speed for attacking batteries, small gunboats, torpedo depôt ships, swift cruizers and torpedo-boats of various classes should coexist with the battle ship goes without saying, but these special ships will frequently find themselves in positions when their speed, or their gun-power, or their torpedoes, or their rams are useless to them, and I do not believe that the empire of the seas can be safely entrusted to a fleet of nondescripts forming a sort of "happy family" of contradictory qualities.

There remains the ram, of which I feel inclined to say as an old friend—

> "Be to my virtues ever kind,
> And to my faults a little blind."

I must, I am afraid, put the ram a little in the background, at least at the commencement of hostilities between fleets, so in spite of the interesting nature of experiments in manœuvring, circle turning, and other questions of importance in handling a ship, I must cut short this part of my subject with the remark that although my old friend may have fallen somewhat behind, I consider that it is a most important weapon, and that the ram-bow of our ships should be at least as strong as that of the ships of any foreign Power.

A short summary of the result of some experiments made whilst I was in command of the "Dreadnought" may be interesting. Probably the whole table will be printed, but the important points ascertained were that the diameters of the circles varied only a few yards, while the average time of completing the circle was 4 minutes 32 seconds at 13·5 knots, and 5 minutes 17 seconds at 11·2 knots. The drift angle was 8° to $14\frac{1}{2}$°.

I conclude my general remarks on ironclads by a list of those recently ordered in England and by different foreign Powers, which shows the policy which is being adopted with regard to ironclad shipbuilding.

England.—In 1885, "Renown" and "Sanspareil," 10,500 tons, "Nile" and "Trafalgar," 12,000 tons, besides six belted cruizers of 5,000 tons "Narcissus" class.

Italy.—Two ships laid down in 1885, viz., "Sicilia" and "Ré Umberto," 13,000 tons, 400 feet length, beam 75 feet; these ships are not to have any side armour, but are to carry four 106-ton guns

mounted in pairs in barbette towers, armoured with 21½ inches of armour, and to carry several light guns.

Russia.—One armour-clad laid down end of 1884, a belted ship called "Alexander II," 8,637 tons, length 326 feet, beam 67 feet, speed 15 knots. Armour 14 inches, tapering to 6 inches at bow and stern; armament, two 12-inch guns in a barbette armoured with 12-inch and 10-inch armour; four 9-inch and eight 6-inch B.L. on main deck, unprotected.

France, Germany, and Austria have not laid down any ironclads recently.

The great tactical question of the day is clearly that of whether big ships and fleets are to continue to exist or whether they are to give place to torpedo flotillas, at least as far as combats in the open sea are concerned, whether, in short, a future naval action is to resemble more or less the engagements of Rodney, Nelson, or Suffren, or whether they are to be a mixed medley or *mêlée* of small craft like Actium or Lepanto.

The views in favour of this latter notion have been put forward with much ability by a French writer, M. Gabriel Charmes,[1] who assures us that ironclads are doomed, that a maritime war will in future consist in the bombardment of defenceless towns by small gunboats, by the ruthless capture or destruction of an enemy's merchant vessels on the high seas by fast cruizers, and by torpedo-boats covering the seas, who will sink and destroy all large fighting vessels. Having satisfied himself that these views are correct, he adds: "At the present hour, the empire of the sea that the squadrons disputed with each other formerly, is nothing more than a senseless word." He seems also to agree with Sir Thomas Brassey[2] that the torpedo is the arm of the feeble, and he supports his argument by certain calculations or miscalculations into which I need not now enter. All this will sound "very pretty fooling" to the members of this Institution, but as M. Gabriel Charmes professes to found his conclusions on the writings of an ex-Minister and the present Minister of Marine in France, it is worth while to examine shortly the views of these men, who certainly write with much ability, and who are occupying or have occupied responsible positions. M. Gougeard's[3] views are that everything is in future to depend upon floatability and speed. The ironclad he gives up as no longer a useful tool, but he cannot bring himself to believe that mere torpedo-boats, which he compares to the fire-ships of the 17th and 18th centuries, will be the fighting vessels of the future. They are nothing but nutshells, he says, and they will disappear like the fire-ships when sufficient speed is given to other vessels. His conclusion is that a future navy will need a few heavily-armed slow ships for attacking forts, and he proposes vessels something similar to the "Scout," of 1,780 tons, with a speed of 20·5 or 21 knots, as "navires de haute mer." That M. Gougeard is

[1] See "Revue des deux Mondes," "La Réforme de la Marine," "Les Torpilleurs autonomes," &c. M. Gabriel Charmes, 1884–85.

[2] "Nineteenth Century," January number.

[3] "La Marine de Guerre," 1884.

somewhat theoretical is evident, but it will be seen that his views are far removed from the conclusions of M. Charmes.

Admiral Aube's theories,[1] as those of a naval Officer and one who has at present opportunities of carrying them out, are of still greater interest. He is even more cautious than M. Gougeard, and rather hints at than directly proposes the abolition of ironclads. He believes implicitly in torpedoes and in fast cruizers, while he thinks that in consequence the sovereignty of the seas is rather a word than a fact, he laughs at the rights of war as illogical, and expects that maritime power "in default of adversaries evading their blows, will attack all seaport towns, whether fortified or not, whether peaceful or warlike, will set fire to them, ruin them, or at least will ransom them without mercy." He further sums up in favour of $5\frac{1}{2}$-inch guns, with their range of 7,200 metres, as sufficiently powerful for the above purposes, a conclusion which I shall show later Captain Chaband-Arnault disputes after the experience of the River Min. It is curious that neither M. Gougeard nor Admiral Aube agrees with M. Charmes on the money question, for while the former says that "only rich nations can pretend to have dominion over the seas," the latter says that in "the present day more than ever money and boldness are the first elements" of naval victories.

These examples show the drift of intelligent foreign opinion on this important subject, and though in this country no similar views have been put forward in print, I think they are shared by not a few of our young gunnery and torpedo Officers, and it is fair to admit that both the screw line-of-battle ship and the ironclad first found favour in France.

There is and can be only one real test of these theories, viz., actual warfare, so I propose to refer briefly to such experience as is at our disposal. Let me take first the capture of the Peruvian monitor "Huascar," in the Chilian-Peruvian War, a good account of which is given in Commander Bainbridge Hoff's work.[2] The case of the "Huascar" was a victory for the gun, as she was captured through the loss of all her principal Officers and a large portion of her crew. She sustained little damage below water and was safely taken into port. It was the old story of a naval action but fought with modern arms. Her two Chilian opponents, the "Cochrane" and "Blanco Encalada," got her between them and she fell a victim to their superior gun-fire.

Lieutenant Mason, U.S.A., whose report Commander Bainbridge Hoff quotes, considers that in this action the Whitehead or any other divergent system of torpedoes would have been "suicidal and dangerous," while no opportunity was afforded for using the ram. He also points out the "Huascar" was much handicapped by not having an all-round fire, which necessitated sheering to bring her guns to bear.

The French operations against the Chinese in the River Min and at Sheipoo in 1884–85, although conducted with much ability by the

[1] "Revue des deux Mondes," 1882, &c.
[2] "Modern Naval Tactics," 1884.

late Admiral Courbet, would be scarcely worthy of notice but for the fact that M. Charmes has loudly appealed to them as victories for the torpedo.

Fortunately M. Chaband-Arnault[1] has given us a sober account of the River Min operations, from which it appears that on the 23rd August, 1884, at the commencement of hostilities two torpedo-boats armed with outriggers slipped from under the shelter of the French ships, and succeeded in destroying two Chinese gunboats, the "Yang Woo" and "Foo-Poo," in broad daylight, of which he speaks as follows:—

"Our boats had, in fact, the good fortune to be posted before hostilities commenced at 400 metres from the enemy, and traversed this distance before the Chinese could make up their minds to fire either gun or rifle at them. The ships, too, were stationary, had no machine-guns of any kind, and no external defence. . . . It would be dangerous indeed to run away with the idea that such an attack could be carried out against the ships of any navy except the Chinese."

Another case of torpedo attack is quoted by Captain Chaband-Arnault, who tells us that—"At 4 A.M. on the 25th August, 1884, two Chinese torpedo-boats attempted a surprise. The first steered for the gunboat "Vipère," which was anchored at the head of the French line. . . . Seen by a look-out on board the French ship, who fired a rifle shot at her, she changed her course for the "Duguay Trouin," which alone, except the "Triomphante," carried the electric light. Thanks, however, to these beams, the "Vipère" was able to point her Hotchkiss with such celerity and precision that the boat was sunk in a moment. The second boat shared the fate of the first."

"Certainly," remarks Captain Chaband-Arnault, who quotes M. Charmes' airy ridicule of the use of the electric light, "the electric beams, with the hail of small shell poured by the Hotchkiss, will not always suffice to protect one or several ships against fast torpedo-boats when well handled. But it is permitted to affirm that often they will contribute strongly towards obtaining this result."

The attack on two Chinese vessels in Sheipoo Roads on the night of the 15th February, 1885, of which a somewhat exaggerated account was given in the "Revue Maritime et Coloniale," turns out to have been of very doubtful importance.[2] The attack was made by two small steamboats of slow speed, belonging to the "Bayard," who succeeded after some difficulty in finding the frigate the "Ya Yuen." It appears that both boats, though acting independently, exploded their torpedoes under the counter of the frigate, which sunk. The "Tchen King" was sunk by shot fired from the shore when the attack took place. The list of damages to the boats, chiefly by fire from the shore, is as follows:—No. 1 boat received 11 projectiles, which fortunately wounded no one; No. 2 received 6 projectiles, one of which killed Fusilier Arnaud. It is worth remarking that both in this attack

[1] "Combats de la Rivière Min." Ch. Chaband-Arnault, "Revue Maritime et Coloniale," 1885.

[2] "Admiral A. Courbet," par A. Gervais.

and in the one in the River Min a boat got her outrigger jammed in the enemy's ship, and that there was difficulty in getting clear, which must have cost the lives of all the boat's crew against any European enemy.

Some remarks of Captain Chaband-Arnault on the River Min fights are worth repeating. He quotes the damages done by the gun to the upper works of the Chinese ships, while their floatability was not endangered, as an argument in favour of protecting the guns and guns' crews by armour, and he also points out not only that the $5\frac{1}{2}$-in. guns of the smaller vessels were useless against the Chinese batteries, but that Admiral Courbet in his official report stated that he did all he could with these small guns of 14 c. "We wanted," he says, "guns of 24 c., or at least of 19 c."

I have explained why I have thought it necessary to dwell in some detail on these operations, and I recommend any out-and-out partizans of torpedo-boats and gunboats to read Captain Chaband-Arnault's "Combats de la Rivière Min." Let me turn now to peace experiments.

Our own experiments in Berehaven and Black Sod Bay last year are full of instruction, and I only trust that these naval manœuvres may be carried out yearly on a similar scale under a chief as bold and as skilful as Sir Geoffrey Hornby. It is unfortunate that the number of torpedo-boats available was so limited as to have afforded little opportunity of thoroughly testing their value, the whole number being twenty, viz., two 1st class, six 2nd class, and twelve 3rd class. These experiments are, however, to be shortly dealt with by Admiral Arthur, so I need only draw a few conclusions from the newspaper reports.

1. I see no reason for the popular belief that blockades are impossible in future, if the proper measures be taken by the blockading squadron, which should consist of at least three lines of ships, nor do I see much risk for blockaders from the enemy's torpedo-boats if their own torpedo-boats be numerous and efficient.

2. A fleet at anchor should always be protected by a triple boom defended by guns and mines.

3. The electric light when intended to protect ships at anchor should be used from special ships or boats throwing fixed beams, the distances of which from the ironclads should be known.

4. Guard boats if used should have special orders and signals, so as not to interfere with the fire of their own ships when they are attacked.

5. Special depôt ships should carry booms and nets so as to enable booms to be rigged rapidly. This is specially necessary now that so many of our ironclads are mastless turret ships.

6. The old 1st class torpedo-boats, which I have placed in the 2nd class, are not fit to go to sea, and the attempt to make them accompany the fleet entailed much discomfort on the crew, and not a little real risk to the boats.

7. The necessity for numerous fast cruizers as look-out ships, and torpedo-boats and catchers to resist similar craft on the side of the enemy.

There were some interesting naval manœuvres carried out in 1884 and 1885 by the Austrians and Germans, with some less complete

ones by the French Mediterranean squadron, of which M. Charmes makes the most as victories for the torpedo-boats, to which I can only allude. Those of the Russian Government in 1884 represented a state of war, and must have been most instructive. A detailed account and remarks upon them is given in the July number of the "Edinburgh Review" of last year, which is well worth reading.

I propose, however, to give only one illustration of these peace manœuvres, which are occupying the attention of all the great maritime Powers, in which the Italian Fleet took part, though my account[1] must necessarily be a scanty summary.

The fleet was divided into two squadrons as follows:—

Eastern Squadron.—Ironclads "Principe Amadee," flag of Rear-Admiral Civita, and "Castelfidardo;" cruizer "Americo Vespucci;" despatch-boat "Vedetta;" and four 2nd class torpedo-boats.

Western Squadron.—*First Division:* Ironclads "Dandolo," Vice-Admiral Martini, and "Duilio;" cruizer "Giovanni Bausau;" despatch-boat "Colonna."

Second Division: Ironclads "Roma," Rear-Admiral Bertelli, and "Affondatore;" steam tank "Verde;" and five torpedo-boats.

The general plan of operations was under the direction of Vice-Admiral St. Bon, the idea being that the eastern or enemy's squadron had taken refuge in one of the anchorages to the north of Sardinia, that which was selected being the fine harbour of Madalena, much used by Nelson in the French war. On October 15th hostilities commenced by the western squadron leaving Cagliari, the "Bausau" and "Colonna" being look-out ships, torpedo-boats in tow of the ironclads.

Before daylight the "Bausau" had made out two hostile torpedo-boats by the electric light, which made off without attacking; it was calculated that they would have been a good quarter of an hour under machine-gun fire from the "Colonna." The attacking squadron wishing to form a base of operations anchored in the port of Liscia di Vacca on the 19th of October, at daylight, having during the two previous days made ample use of the torpedo-boats and steamboats of the squadron to search out the various bays and inlets surrounding the island of Madalena, while at night an inshore line of torpedo-boats and an outer line of ironclads blockaded the eastern squadron. It was difficult for the latter to guard all the entrances to the harbour, and two were found to be unobstructed by mines or booms. The eastern squadron seems to have had a boom round it, as one flotilla of boats of the attacking squadron was taken while reconnoitring it at night. From the 19th to the 21st the weather, which had been favourable, was bad, which rendered operations difficult, but several ineffectual attempts were made to surprise the blockaded squadron, which resulted in the loss of boats to the blockaders. On the other hand the "Castelfidardo" was put out of action by a fishing boat

[1] Summary taken from Account in French paper "Le Yacht," 5th December, 1885.

armed with a torpedo being unsuspectingly allowed to come alongside, which stratagem, I may remark, seems to me absurdly unpractical, as the disguised sailors must of course have been shot as spies in real warfare, and it is enough to say that it could have been practised with equal success by Bushnell more than one hundred years ago, so that those detailed for such an enterprise would probably prefer "comfortably floating on the water," well clear of the enemy, as remarked by Mr. Nordenfelt about the occupant of Bushnell's diving-boat.

At the same time torpedo warfare seems to lead up naturally to similar "devilish" inventions, as they used to be called, and the moral is that every possible precaution should be observed. By this time the attacking squadron had lost most of its boats, and the blockaded squadron one big ship. Admiral Martini then arranged to make a night attack with his ships, disguising the "Verde" as an ironclad so as to draw the torpedo attack. But before he could attack, Admiral Civita attempted to escape by the Pass of Nido d'Aquila, where the south-west corner of Madalena approaches Sardinia; here, however, though the night was dark and windy, they were met by an enemy's torpedo-boat which was taken, but gave the alarm, and brought the "Duilio" on the scene, to which the "Amadeo" and "Vedetta" hauled down their colours after a brief action. This necessarily incomplete account of operations, not very complete in themselves, as the Italians had no net protection and were deficient in cruizers and torpedo-boats, shows how eagerly naval Powers are seeking a solution of the varied problems connected with naval tactics.

From the previous remarks my idea of a modern fleet may be easily gathered.

It certainly cannot depend solely on ironclads. Indeed a squadron consisting of ironclads alone is essentially a notion resulting from a long peace. Nelson before Aboukir bitterly complained of the lack of frigates, and stated that if he died the word frigates would be written on his heart; the "Pickle" schooner may be seen among the line-of-battle ships in the Trafalgar Model of this Institution; and when I first went to sea, Sir W. Parker's squadron in the Mediterranean was usually escorted by as many steamers and small vessels as it had line-of-battle ships. Now clearly, look-out ships and fast cruizers, as the eyes of the fleet, are more than ever indispensable. I therefore submit the following as a suitable proportion for a fleet of the present day intended to act at sea. If acting inshore gunboats and coast-defence vessels would necessarily be added. Assuming an ironclad fleet of twelve ships as the basis, the numbers should stand about as follows:—

	12 ironclads, say	6,000	men
	4 frigates ("Leander" class)	1,600	,,
	12 "Scouts," look-out ships	3,000	,,
	24 "Grasshoppers" (torpedo-catchers) ∴	1,500	,,
	50 1st-class torpedo-boats	750	,,
	2 torpedo depôt-ships	600	,,
Total..	104 ships.	13,450	,,

alongside,
ractical, as
ies in real
practised
rs ago, so
fer "com-
remarked
-boat.
turally to
, and the
By this
and the
ranged to
le" as an
he could
s of Nido
aches Sar-
ndy, they
gave the
vhich the
er a brief
not very
and were
rly naval
cted with

t may be

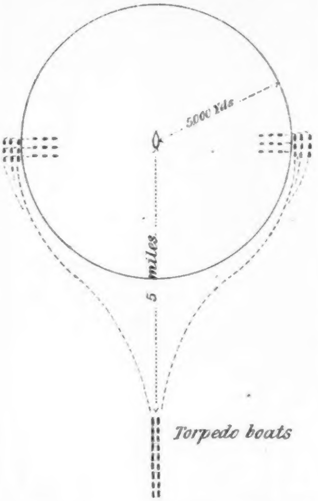
squadron
g from a
d of the
would be
mong the
tion; and
Mediter-
ll vessels
and fast
spensable.
a fleet of
gunboats
ming an
uld stand

en
,,
,,
,,
,,
,,

,

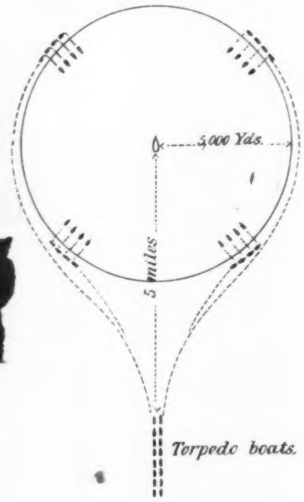
No. III.

RUSSIAN OFFICIAL PLAN OF TORPEDO ATTACK.

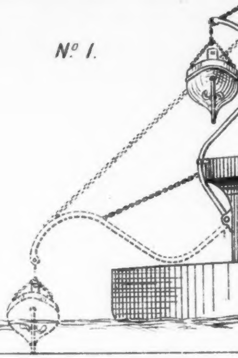


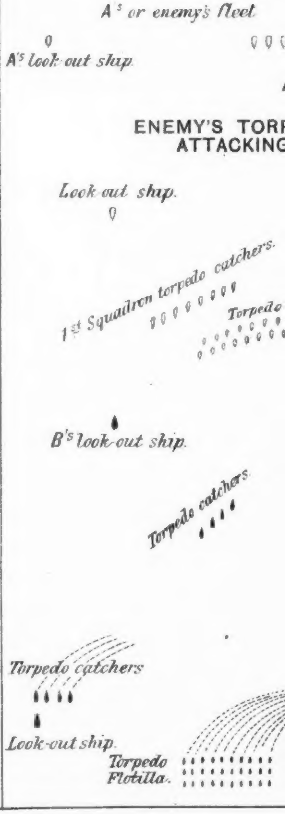
No. IV.

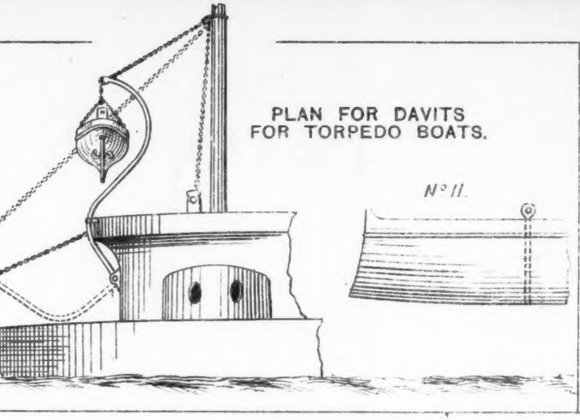
CAPT. AZAROF'S SCHEME OF TORPEDO ATTACK.



No. I.

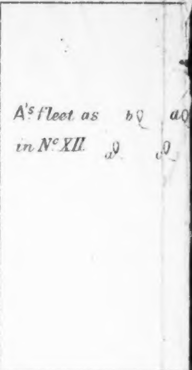


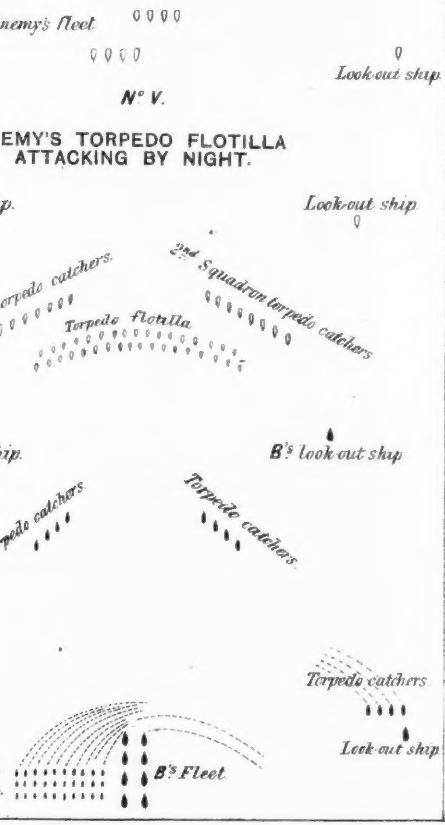




PLAN FOR DAVITS FOR TORPEDO BOATS.

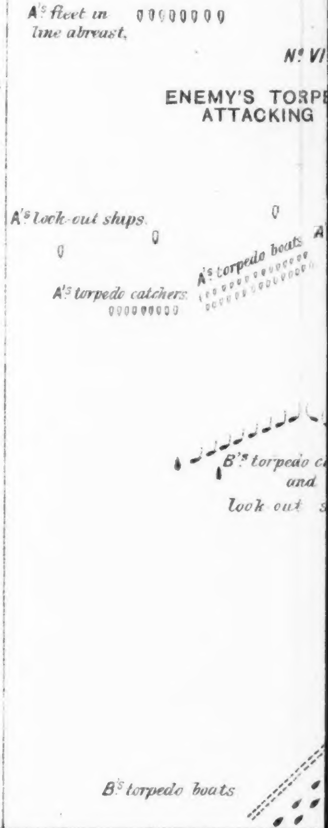
Nº II.





Nº V.

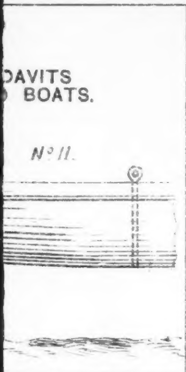
EMY'S TORPEDO FLOTILLA ATTACKING BY NIGHT.

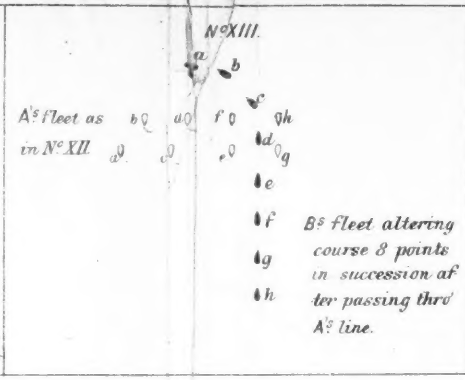


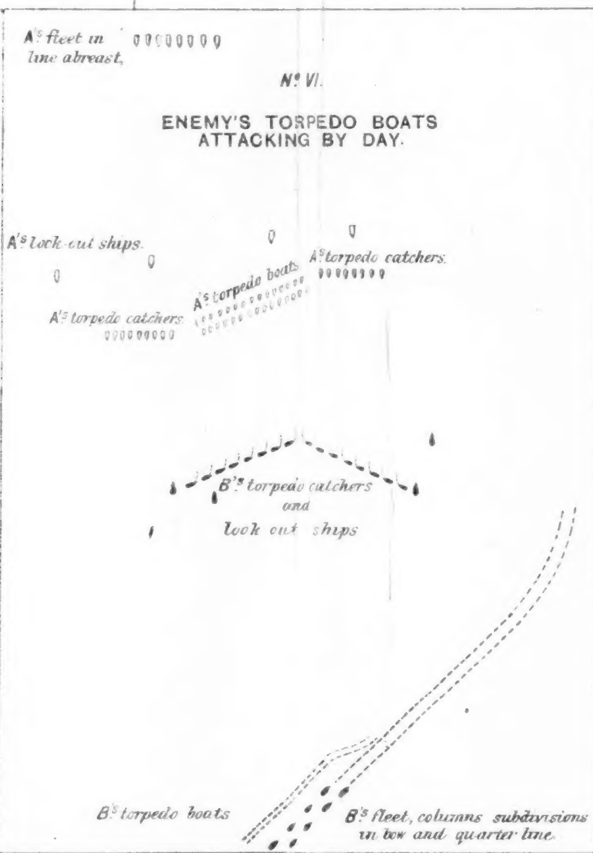
Nº VI

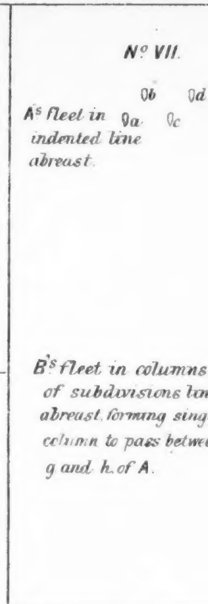
ENEMY'S TORPE ATTACKING

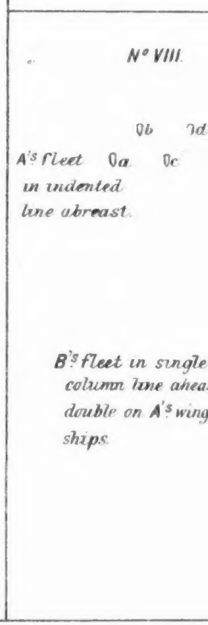
Harrison & Sons Lith. St M.





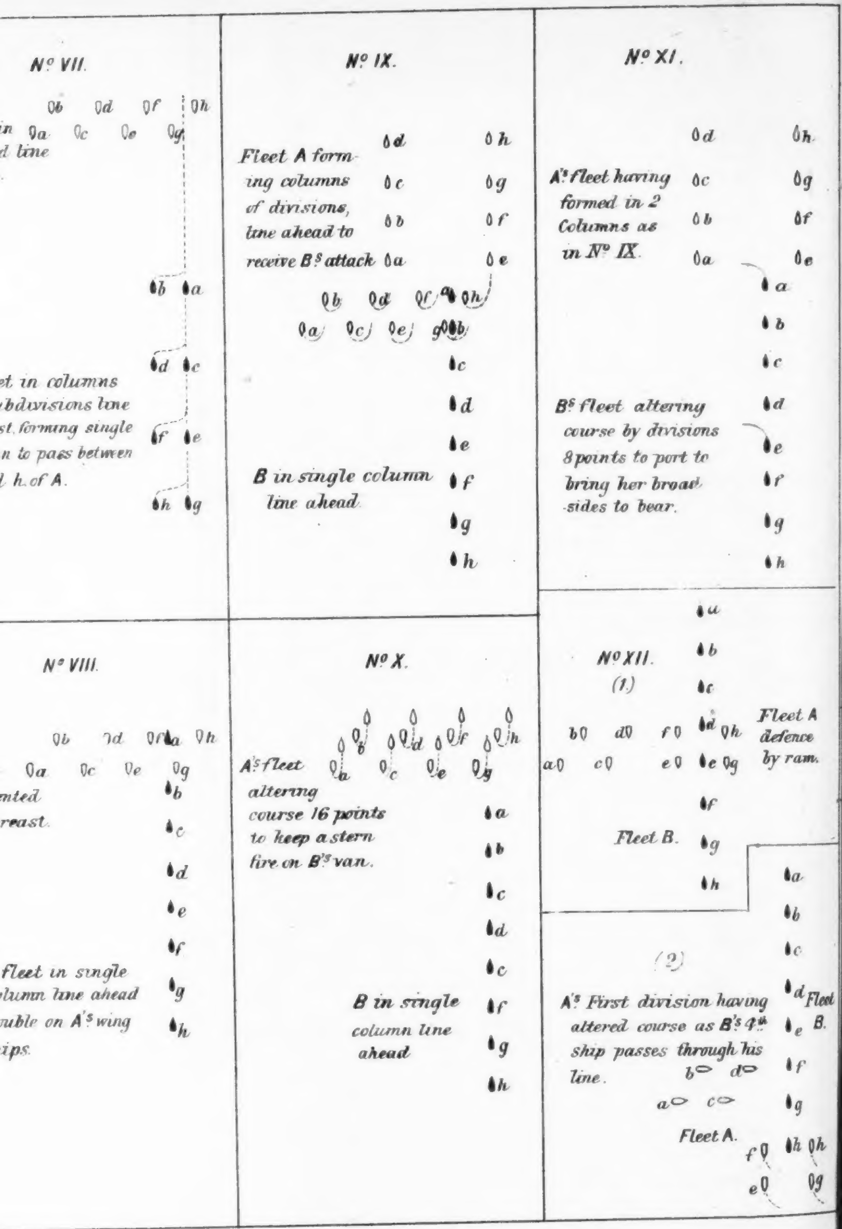






Harrison & Sons Ltd. St Martin's Lane, W.C.

Plate VIII.



Nº VII.
in
d line
et in columns
bdivisions line
st. forming single
n to pass between
l h. of A.
Nº IX.
Fleet A forming columns of divisions, line ahead to receive B's attack
B in single column line ahead
Nº XI.
A's fleet having formed in 2 Columns as in Nº IX.
B's fleet altering course by divisions 8 points to port to bring her broad-sides to bear.
Nº VIII.
nted
reast.
fleet in single
lumn line ahead
uble on A's wing
ips.
Nº X.
A's fleet altering course 16 points to keep a stern fire on B's van.
B in single column line ahead
Nº XII.
(1.)
Fleet A defence by ram.
Fleet B.
(2)
A's First division having altered course as B's 4th ship passes through his line.
Fleet B.
Fleet A.

Our fleet, therefore, would consist, in round numbers, of 100 craft, half of which would be torpedo-boats, and about 13,000 men.

Now for the organization and evolutions of the fleet, and I think I hear some of my naval friends muttering, "I thought so, that is a big question which may well take him to the end of his lecture." So I say at once that, important as these points are, I can well afford to leave them with only a few remarks. I am generally content with the organization of our fleet into two, three, four, or five divisions, and each division being divided into two subdivisions, but I fail to see why each division could not be divided into four subdivisions, should the Commander-in-Chief prefer. (This would, I am aware, require a few additional signals.) At present, with sixteen ships, should the Admiral prefer to fight in pairs, he can only make his pairs subdivisions by forming his fleet into four divisions, which when in columns of divisions line ahead would occupy an extended front of 2·4 miles. I should myself prefer sailing in two columns 1·6 miles apart, but I could not then have subdivisions of less than four ships.

These are questions, however, which can be better discussed with the Signal Book before us, and by a Committee of experts at the Admiralty. It is more to the purpose that I see little advantage in dividing the fleet into threes, and that I see none whatever in the service groups, except as an evolutionary trap for the unwary.[1] Their origin, their history, their variations, the unremunerative time and thought expended on them should be argument enough. I do not think them worthy of serious consideration, but if any Admiral of experience informs me that it is a formation which he would adopt in preference either for sailing or fighting, I am, of course, ready to reconsider my opinion.

The torpedo-catchers and torpedo-boats should, I hold, have separate organizations, a junior Admiral, or Commodore, being in charge in each case. The 24 "Grasshoppers" I should divide into 3 or 4 divisions, the 50 torpedo-boats into 4 divisions, leaders of divisions to have pole masts for signal purposes. These vessels should cruize separately from the fleet under their own Commander, who should be responsible for all details, and only a few simple movements should be attempted.

The whole to be under the orders of the Commander-in-Chief of course.

As regards evolutions, I think our system of rectangular movements decidedly superior to that generally followed in the French Navy, which consists of oblique movements.[2] We should, I hold, always be in some formation night or day, during fog, leaving or entering harbour, or at anchor. If when at anchor the Admiral prefers to place himself in a special position, the fleet should weigh in that formation and assume any prescribed order afterwards by a proper evolutionary movement, the practice of weighing independently, and form-

[1] See Lieut. Farret, "Revue Maritime et Coloniale," 1883.

[2] See some very interesting articles in the "Revue Maritime et Coloniale," 1883. By M. Farret, Lieut. de Vaisseau.

ing outside the port, being a relic of sailing days, when the "outward- and leeward-most ships" necessarily weighed first, though of course it may still be necessary in a close harbour like Malta. This is the course generally now adopted by our best Admirals.

A word about signals. Our present flag signals have stood the test of years of evolutions, and have scarcely been changed for the last quarter of a century, but they are inapplicable to action in the present day, for the simple reason that while guns' crews and Officers in conning-towers are more or less fully protected, the signalman, his halliards, and his flags are exposed to machine-gun fire. The semaphore has been tried for evolutions, and if the semaphore can be fairly trusted I would suggest a plated tower for the signalmen, or a portion of the conning-tower being kept apart for their use, whence a large semaphore could be worked in action. It has been suggested that the arms of this semaphore should be worked from the top of a "military mast" in our turret ships, which seems worth a trial.

I come now to pure tactics, say 1 to 1 of equal force. This has been well threshed out on previous occasions. It will generally be decided by the gun, as I hold that, at first at least, ships will mutually avoid the chance of a fatal torpedo shot, and for this reason a ship will endeavour to keep rather before the beam of her opponent if broadside to broadside, or if circling round she could keep either near the enemy's bows or stern, according as her own bow or stern fire was the stronger.

In either case speed is of the first value. In a single ship action I should certainly advocate the use of torpedo-boats if they could be prepared in time; they would keep under shelter of the ship till the opportunity offered of making a successful dash under cover of smoke. It is essential that the torpedo-boats should have superior speed to that of the ship. A ship with better manœuvring power but inferior in other respects should try to ram at once.

It is more important to consider the attack of an ironclad by torpedo-boats, which has been much discussed in Russia.

In the Russian naval magazine of December last a Captain Dubuzof discusses some plans of attack of a Captain Azarof, which differ somewhat from the recommendations in the Russian Official Manual for Torpedo-boats. The manual adopts eighteen boats in two lines as a squadron, and recommends that each line should form three lines abreast (see Fig. III), endeavouring to get abeam of the ship to be attacked, when all bear down together. Under such tactics each line of boats would be in danger of being enfiladed by the ship. Captain Azarof's scheme consists in dividing the two divisions into four squadrons, say, of four boats each, the boats then keeping outside of the range of the ship's guns, endeavour to form on the circumference of the circle either N., S., E., and W., or N.E., S.E., N.W., and S.W. of the ship as ordered, and when in their positions all bear down on the ship together. It will be seen that each squadron will thus be in line abreast and no enfilading is possible (see Fig. IV). Azarof thinks that the best tactics for the ship would be to steer direct for one of the squadrons. Anyhow the ship

would be in a critical position, as the squadron steered for might separate, and two boats at least would get easy shots. It would, however, be difficult to make the attack simultaneously, as the squadrons would be 3 miles apart. Under ordinary circumstances a ship attacked by only one or two torpedo-boats would turn her stern to them so as to keep them under fire as long as possible, and from astern when firing at a ship steaming 14 knots the torpedo would have to be fired at about 150 yards to ensure its reaching her.[1] I do not myself contemplate torpedo-boats attacking squadrons or even single ships in broad daylight or under favourable circumstances for the ship; they would naturally choose darkness, fog, or smoke. The attack in the daytime might succeed, but the sacrifice of life, though lightly spoken of, by civilian writers especially, would be too great, and men are easily demoralized when under fire and unable to make any return.

I do not, therefore, assume an attack by a flotilla of torpedo-boats and vessels on a fleet when undefended by torpedo-boats, but it is probable that the old half-moon formation of the Venetian galleys would be the best, care being taken not to allow the horns to be enfiladed by the wing ships. It would be folly to expose our costly ironclads to such an attack, but I believe it would be repulsed with great loss of life to the assailants, although I admit that they might sink a ship or two.

On the other hand, at night the advantage would rest with the torpedo flotilla in such a case.

Now let me consider how an action would be likely to be fought between my ideal fleet composed as I have proposed, and one of similar force.

I do not believe that torpedo-boats would act as skirmishers, or that they would rush past each other to the attack of the ironclads, as supposed by Admiral Elliot.[2] The view taken by the author of the Battle of Port Saïd[3] is, I think, more probable, but I do not suppose that it would be advisable for the ship's torpedo-boats to be hoisted out, and to attempt to keep with her in a general action, as suggested by him.

The enemy might try a torpedo attack with all his small vessels at night as a surprise; in this case the look-out ships and torpedo-catchers which would be acting as the eyes of the fleet would at once attack them and endeavour to throw them into confusion. The fleet attacked would do best probably by not firing a shot, but by changing position rapidly in line of battle, or columns of two divisions two cables apart, and keeping their own flotilla of torpedo-boats between them and the enemy's. Should the torpedo attack fail, or a confused fight ensue, then would be the time for a counter torpedo attack on the enemy's fleet, if its position were known. The difficulty of arranging signals so as to distinguish friend from foe would in any case be great in such a *mêlée* of small craft, and the principal endeavour

[1] A 20-knot torpedo-boat coming up astern of a ship steaming 14 knots would be 6′ 15″ within 1,500 yards, or under easy machine-gun fire.

[2] "Future Naval Battles and how to Fight them," 1885. By Sir George Elliot.

[3] Battle of Port Saïd, from "Engineering," July 1883.

should be to avoid panic and confusion. The torpedo-boats having little offensive power, the torpedo-catchers would do as well without them as with them, and it would be advisable to keep the torpedo-boats in hand till they could act on the offensive with effect (see Fig. V). Should a similar attack be attempted by day, which I think improbable, the tactics would be somewhat the same; but I hold that a skilful Commander-in-Chief would probably endeavour, even at some risk, to cut off the enemy's torpedo-boats (see Fig. VI). It is possible again that the enemy might use his torpedo-boats as skirmishers, supporting them with his battle ships; in that case when our Admiral saw that the torpedo-boats were keeping near their own ships, he would probably recall his torpedo-catchers, and trust to his gun-fire, which could not well be returned by the enemy without danger to his own boats.

I do not suppose from the above that our possible enemy will be less wary than ourselves, but I wish to show that some popular views are mistaken as to the part likely to be played by torpedo-boats in a general action. I think with the author of the "Battle of Port Saïd" that they will act as a sort of reserve when favourable opportunities offer, always assuming that both fleets are on even terms as regards numbers of torpedo-boats.

I think then that an action will be commenced by the ironclads and heavy rams of the "Polyphemus" type, and that from fear of the torpedoes carried, it will begin by skilful manœuvring, the gun being the principal weapon. Should this be the case, speed, as I hope to show, is of the highest importance.

I have now simplified my problem by reducing the question to a fleet action between ironclads, the gun being the chief weapon; but I would add here that the ram would naturally be used in self-defence, and torpedoes would be fired as opportunity offered.

To consistency with what I have formerly advocated I make no claim, except as regards main principles. These are that the Admiral must choose the weapon with which he will fight and subordinate his tactics to that choice.

"There is no making of omelettes without breaking of eggs," and there may be several ways of breaking them, but a cook who hesitates how or with which particular instrument he will break them, will probably find that a rival has meanwhile made his omelette. This is a homely illustration of Tegethoff's success at Lissa. He chose the ram as his weapon, and made use of it while Persano was hesitating.

So much for principles. The detailed suggestions for tactical fighting formations have varied considerably, though writers have usually very properly made them subservient to the weapons on which they intended to rely. A review of these opinions would be most interesting, but I have only space for a brief summary.

Both foreign and English writers have generally assumed line abreast or some modification of it, such as indented lines abreast, or lines abreast by divisions as suitable to ramming tactics, while those who have advocated reliance on the gun have gone back to line ahead

or some modification of it. Thus the French Admiral Bourgois, writing in 1876, advocates one line abreast, one cable between each ship for attack by the ram, and this has been very generally adopted by French writers, Gueydon, Penhouat, and others.

Captain Colomb, R.N., as long ago as 1872, went back to line ahead (the old line of battle), so as to "double on the enemy," using his guns. Lieutenant Grillo, of the Italian Navy, writing as late as 1881, distinctly prefers line ahead for a gun action; he is against line abreast, and he considers the form of three ships affecting a triangular form to have scarcely any military value.

These are examples taken almost at random, but in spite of numerous exceptions and some neat but unpractical ideas such as that of the naval square of Admiral Bouet-Willaumez, which have made thinkers like Jurien de la Gravière sum up "that there is no fundamental order of battle, but that bows must be pointed towards the enemy," the rule stands out clearly, "For the ram use your bows, for the gun use your broadside."

That one view must modify the other is evident, for no Admiral would dare to commit the mistake of the Italians at Lissa of exposing their broadsides to the rams of a hostile fleet, and a long line must be in danger of having its extremities overwhelmed by a better concentrated enemy. On the other hand, a concentrated force masking their own guns would form a good mark for ships in line of battle. There is no more reason why a fleet with a broad front should not be employed to meet one attacking with a narrow front than that a battalion in line should not meet one attacking in column.

Let us now follow one or two ideal movements. Squadron A (see Fig. VII) is in indented line abreast, and is met by a Squadron B in columns of subdivisions line abreast. Squadron B, when at about ten cables distance, forms single column line ahead to starboard, and passes between A's *g* and *h*. The object of B was to crush the three wing ships of the enemy by pouring sixteen broadsides into them. On the other hand, A's squadron would have poured a heavy bow-fire into B's van ships as they came up. (See Fig. VIII.)

This or some similar movement was actually carried out between opposing squadrons under Sir G. Hornby last year. The Admiral of A should, however, be prepared for this, and he could either alter course sixteen points and form columns of divisions line ahead on *d* and *h*, thus endeavouring to get the head of B's column between two fires (Fig. IX), or by simply altering course sixteen points he would keep the stern fire of his eight ships on B's van (Fig. X).

In either of these cases A would avoid the torpedo. Supposing, however, that the Admiral of A decides to use the ram, and that his orders were that his ships should act in pairs, in readiness for such a movement as B's, *g* and *h* and *e* and *f* would have been ordered to form line ahead, thus forcing B to go inside the two former, and he would have to fight four ships instead of two or three. If A's first division were to alter course eight points to port, as the 4th ship of B passed through, they could either ram B's two rear ships or surround them (Fig. XI). Any of these movements would have to

be concerted beforehand, and would, I think, place B in an awkward position.

No. (1) would be most effective probably.
„ (2) would be simplest.
„ (3) the most dangerous.

Should B perceive that A has adopted or is intending (1) or (2), he would probably alter course in succession eight points to port, and so bring his broadsides to bear, but A in that case altering course eight points to starboard would bring a heavy fire to bear on B's van ships as they came up, A's better course would be to alter course eight points by divisions, but his first division would in any case suffer (Fig. XII). An answer of B to the (3) movements of A would be to alter course eight points in succession to port as he passed through A's line. (Fig. XIII.)

These illustrations serve to show the weakness of the long line, a weakness of which now as formerly a skilful enemy can always avail himself in spite of its theoretical value. It naturally increases according to the number of ships. It may be fairly strong with six, weaker with eight, dangerous with twelve ships. The indented line which I have referred to is that practised in our Navy.

There are two in use, and I have taken the one that is least objectionable, but I do not like either. Greater flexibility with much the same formation can be obtained by columns of subdivisions of two ships in bow and quarter-line.

To carry out evolutions (1) or (2), at superior or at least equal speed, good turning-power and a powerful stern-fire are indispensable.

I am afraid that vessels like the "Renown," "Sanspareil," "Conqueror," or "Hero," with their bow-fire only would, to use the ordinary phrase, be rather "out of it." It is evident that an attempt of B to force A's centre would be more easily frustrated than an attack on the wing ships. In meeting an enemy formed in line ahead, I should prefer columns of subdivisions in line abreast, leaders of subdivisions at four points bearing. This formation seems to me flexible, and to give better mutual support than the indented line ahead. Probably some such formation, but divisions in line abreast, would be best in meeting an enemy formed in line abreast. In either case an alteration of four points would bring all broadsides to bear.

Simple compass signals only would be used to denote the course while manœuvering in action, a distinction being arranged between altering course "in succession" and "together;" ramming or torpedo attack would follow the gun action. Ships should be ordered to act as much as possible with their pair.

With these experimental hints I leave the question of action tactics, but the most important point of all remains.

It is essential that the Commander-in-Chief should have decided in his own mind how he should use his weapons, and that his plans for foiling any attack of his enemy should be matured beforehand. The main principles and even the details of these plans as far as possible should be understood and appreciated by the Junior Flag Officers and the Captains of the Fleet.

This last was in great part the secret of Nelson's success, yet hidden as it were under the seductive qualities of personal heroism and dash, it needs to be often repeated.

Mr. Laughton quoted to us a short time ago Sir Edward Berry's testimony to Nelson's "masterly ideas on naval tactics, with which every one of the Captains of his squadron was most thoroughly acquainted," and exposed for the hundredth time the error as to Nelson's views, which has found common acceptance in the phrase attributed to him, that "no Captain could do wrong who placed his ship alongside one of the enemy;" the fact being that this phrase is not only inaccurately quoted, but that it appears at the concluding sentence of a long memorandum of instructions.

The Captains must have confidence in their chief, so as to understand him, to use Jurien de la Gravière's phrase, "à demi mot," mere good humour and courage will not give this confidence, which must be founded on the qualities of the Admiral in command.

There is an anecdote which I have perhaps read somewhere, though I think I was told it by an old Officer, which illustrates my meaning of the intimate confidence, that plant of slow growth, which should exist between Admirals and Captains, and which all our best Admirals have been able to inspire. A couple of days before Rodney's action in 1782, while the British and French fleets were in sight of each other in the calm tropical weather of the West Indies, one of Rodney's most distinguished Captains, who I will call Captain G., pulled alongside the flag-ship, and on seeing the Admiral, who was a personal friend, he implored him to let him go home, as he felt sure that he would disgrace himself in the impending action. Rodney, knowing that this was a mere temporary weakness, firmly but kindly sent him away at once, saying "Nonsense, G., do your duty as you have always done hitherto, or I shall try you by a Court-martial." Captain G.'s ship was hotly engaged in the action which ensued, and the Captain behaved with even more than his usual gallantry.

I am told that I ought to make some allusion to Mr. Nordenfelt's diving-boat, and to the effect which such inventions will have upon tactics. I have not done so in the lecture hitherto, as the greater part of it was already written when his lecture was delivered, and I looked upon his diving-boat as merely a development of the torpedo attack.

He gains in secrecy and invisibility, but loses in speed. His 100-foot boat will probably be more easily made out when with cupola above water than the smaller specimens. We may expect later on to hear of still larger and more conspicuous seagoing diving-boats. All inventions modify tactics, but I confess that, speaking generally, I am an unbeliever in cheap and easy ways of annihilating naval power, whether of England or of other nations. From Bushnell, Fulton, and "long-range" Warner, to M. Gabriel Charmes and Mr. Nordenfelt we have the same idea; yet booms and nets will keep out diving-boats as easily as other torpedo craft, and a diving-boat caught under water would make a nice Mahomet's coffin for her crew. The 300 lbs. dynamite torpedo, when it comes to fruition, can probably be made to

explode prematurely, and the boat might be "hoist with her own petard," as the Duke of Edinburgh suggested. Shortly, a diving-boat is to fight by stealth and to run away. It must be reckoned with, and will probably have its isolated successes, as have had other torpedoes which destroyed the "Housatonic" or the "Albemarle" in the American War, or the Turkish gunboats on the Danube, but Farragut pressed in at Mobile in spite of the loss of his leading ship by a torpedo, calmly saying, "What's the trouble?" and these successes have generally rather modified than materially changed naval tactics.

"He who fights and runs away may live to fight another day," but such methods must be ever subsidiary to that open fighting, which will eventually command the situation, either by sea or land.

The CHAIRMAN: Admiral Fremantle has given us a very extensive field both for discussion and thought. We shall be glad to hear the opinions of any one present who wishes to make any remarks on the lecture, bearing in mind that in the discussion over such an extensive field, it will be advisable to keep to the points raised; so many important questions have been brought to our notice, that if we ramble over or stray from the subject our discussion might be indefinitely extended.

Captain BETHELL: Sir Cooper Key, ladies and gentlemen, I do not propose to offer any lengthened criticisms upon the very interesting paper we have just heard, because I have not had the opportunity of studying it beforehand, and without such an opportunity it would be, I think, extremely improper to attempt any detailed criticism. There are, however, just one or two points that have occurred to me, and possibly to most other gentlemen here, in connection with those subjects at various times. One of these is the question of big ironclads. Admiral Fremantle holds the view, which I believe is held by many Officers in our profession, that the large ironclad ought to be and will be continued. Now it appears to me that that view, and I say this without any disrespect, is not in my judgment a practical or a very logical one, and for these reasons. Everyone who speaks or writes of naval tactics admits that the large ironclads must be defended by torpedo-boats and other small craft. Surely if that be the case we are led to the conclusion that the small craft are better for fighting purposes than the big craft. If it be essential to defend the big craft by the small ones, surely we must logically be led to the conclusion that small craft are better than big ones for fighting purposes. Let me give an illustration of what I mean. Assuming that there are two fleets of ironclads each defended by torpedo-vessels, if it were possible for one of the Admirals in command to have the power of removing a big ship and replacing it with a small one, clearly he would do so, because he would then have the advantage of his original torpedo-ship, and then of his second torpedo-ship against the ironclad of his adversary, and everyone admits that the torpedo-vessels have the advantage. Of course it will be said at once by naval men that it would be absurd to propose to substitute for ironclads more torpedo-vessels, and that is perfectly true because there are so many occasions upon which guns and big ships are required in our profession; but I ask if the tendency of the progress of naval science is not on that account alone towards decreasing the size of the ship rather than towards increasing it. Instead of increasing it, looking at the illustration I have given that the small craft are after all of the greatest importance in naval actions, which is the great thing we have to consider, does it not show that the tendency of naval progress ought to be towards decreasing the size of the ship? There is just one other point which was alluded to in the lecture, and that is the question of turning our ships. I conceive that that is perhaps one of the most important phases of evolution which must take place in our fleet. It is a very curious circumstance, that in spite of all the progress that has been made in ships, we are still practically turning our vessels by exactly the same method in which vessels were turned

a hundred, or any number of years ago that you like. It is true that with machinery we have improved the method of moving our rudders, but we still have to rely entirely upon the rudder for turning ships. So long as rudders do all that is required there is not the smallest objection to them, but they do not do all that is required, and it is curious we so seldom find that professional men go very much into the subject of the necessity of turning vessels, not in a small space so much, but with very great rapidity. In my humble opinion the power of turning not in a small space, but with very great rapidity, will be the power which in all probability in future will give success to a fleet or to individual ships. No doubt one of the reasons why this has never been developed to any great extent is simply that there is no demand for it except in fighting ships. In the Merchant Service and in the other great steamers there is no demand for turning with rapidity, and consequently it is a subject which does not exercise men's brains. I think, considering the development that is taking place in torpedoes and also in the ram, it is perhaps one of the most important subjects that can be attended to in connection with our fleets. I should like to conclude, if I may be permitted, by expressing my acknowledgments to Admiral Fremantle for the extremely interesting lecture which he has given us, which I feel sure will constitute another step in the interesting and important study of naval tactics.

Captain the Honourable THOMAS BRAND: I am sure Admiral Fremantle will forgive me if I say naturally, on rising to speak on a subject of this sort, that criticism is the first thing, and I shall begin at the beginning, though with many apologies, by criticizing the name of his paper. To my mind it would have been better named "Naval Warfare," because of necessity in his paper he dismisses tactics at what I think was rather short notice. There are two or three points in the paper that I should like to mention. One is the great importance of a good method of lowering the torpedo-boats. I think that possibly boats might be carried further inboard, and moved out on a railway line in the same way as they do the trains in France. In the "Swiftsure" the other day we had our boats carried on a tramway, and if they could have been moved down by these means so as to be immediately under the davits, the work of lowering them would have been very easy. To come to the tactical part of the lecture, Admiral Fremantle objects to the group. I am sorry that I have not sufficient experience to make him reconsider his decision, but I rather like the group, and I should like to point out that in dismissing groups he goes in for pairs. Now to my mind there is very little difference between two and three ships. I prefer the three, but if you want to work your fleet in pairs, and if we intend to have a new organization, why not have the organization in groups? Your ships do not have in the group their bow-fire masked, which is a great point, and I think further that the group system gives more flexibility than any possible formation that I know. Of course if you have groups and call them "pairs" you come to the same thing, but to say that the groups are utterly condemned is, I hope, not quite true.

Captain CYPRIAN BRIDGE: I should like to ask, Sir, with your permission, one question, whether Admiral Fremantle can give us any account of the extent to which the Whitehead torpedo has been used by the French in their operations in China?

Admiral FREMANTLE: I believe the Whitehead torpedo was not used at all.

Captain BRIDGE: Another question I was going to ask was, Whether in the Admiral's ideal fleet, the aggregate of which amounts to something over 100 vessels, the torpedo-boats making up that aggregate, include or are composed of the torpedo-boats carried by the ships themselves? My only reason for asking that question is this: I think it would be a very unfortunate thing if it should go forth to the public, especially with such a distinguished name as that of Admiral Fremantle's attached to it, that each ideal fleet of the future is to be composed of over 100 pendants. In spite of the mendacious—I suppose that word will hardly be regular, so I will call it the insincere—frequency with which we hear it said that no money or no sacrifice would be refused to put the fighting fleet on a proper footing, I think if it once went forth that we wanted for each of our ideal fleets as many as 100 ships (in all probability it would when it got into the newspapers), we should find that any attempt to get a fleet of the proper

strength would not be listened to for a moment. I should be very glad if the Admiral could tell us whether the torpedo-boats in his fleet are composed to a great extent of the boats carried by the ships themselves, so that the dimensions of the fleet would not be extended so greatly as might otherwise be supposed from his statement.

The CHAIRMAN: I think Admiral Fremantle only intended to give the proportion of large and small vessels that he would recommend in an ideal fleet, and not to give what he considered should be the smallest fleet or the largest fleet that should be collected together.

Admiral FREMANTLE: I propose an ideal fleet of twelve ironclads, and I say that suppose you had twelve ironclads I think that you ought to have all these additional small craft. But in my examples I only gave eight ships; I therefore do not hold to the necessity of having twelve ships; you may halve the number if you like. I have prepared a calculation as to what I think the expense of such a fleet as I have proposed of twelve ships would be, to which I will allude in my general reply.

Captain HAMMILL: In coming here to-day to listen to the admirable lecture we have just heard from Admiral Fremantle, I must confess my first thoughts were that I did not know what the lecture would be about—I had no idea what "naval tactics" were—I mean in the present day. I cannot conceive how you can build up any satisfactory system of modern naval tactics on what has gone before. If you take an ironclad of the present day with all her fighting machinery, modern appliances, and auxiliaries, and compare her with an old line-of-battle ship, there is nothing in common between them. Therefore, you cannot compare a system of tactics or order of battle suitable for one with a system or order suitable for the other. What we suffer from appears to me to be this: that we have no "school of tactics" whatever in the Navy. I know that some years ago Captain Colomb brought out a very capital war-game, which, I believe, has been widely taken up abroad, by Russia especially. I have read occasionally of naval war-game battles having been fought in that country. For my own part, although I have seen a great deal of what has been going on in the Service the last six or seven years, or since the war-game was invented, I have seen one naval war-game fought, and one only, and that on board the "Vernon," I think, in 1879. No doubt many others have been fought, perhaps even in my own ship, without my knowing it, but what I mean to convey is this, that as an Officer who has been in the Service and serving I have not seen or heard of a single other war-game being fought than the one above mentioned. The only way, in my opinion, in which we can learn modern tactics is by thoroughly discussing the systems that might be adopted, and by practising them in peace-time, so that we may be prepared to follow some system in time of war. I am not prepared to propose a better system of naval tactics than what Admiral Fremantle advocates, or any system, in fact; but I think there is ample room for examination and inquiry into the subject.

Sir THOMAS BRASSEY: As Admiral Fremantle referred to a phrase which occurred in a contribution which I made to a magazine, I should like to say a word or two in explanation of the meaning which that expression was intended to convey. The phrase that "torpedo-boats were the arm of the feeble" occurred in a paper in which I endeavoured to show that the Board of Admiralty, which in its shipbuilding policy was largely influenced by your advice, had made an honest endeavour to develop the strength of the Navy. They may not have gone on as rapidly as we might have wished, but our hope was that we were moving in the right direction. What was the policy of that Board? I am not going, of course, to enter into that at any length, but the policy of that Board in its earlier years was to give a decided development to the armoured construction of the Navy. The torpedo-boat was not considered by you, Sir, I believe, if I rightly understand your view, to be the arm to which in time of peace, in the circumstances with which we had to deal five years ago, we should direct our principal efforts. In the later years of the Administration with which you were connected, a great effort was made to add to the strength of the Fleet in sea-going torpedo-vessels, and you, Sir, I believe, were of opinion that a sea-keeping torpedo-vessel was more important to the British Navy than a boat whose zone of action was limited to the defence of harbours. That

policy was the policy which you recommended to a Power which claims to be the mistress of the seas. Torpedo-boats designed strictly for harbour defence are, of course, a most important feature in the naval preparations of those Powers which do not attempt to hold a great position on the high seas, but which are looking chiefly to the defence of their coasts. Before sitting down I should like to say just this with reference to the shipbuilding policy of the future: all that I have heard from naval authorities satisfies me that those who have the direction of the expenditure of the nation upon its Navy should endeavour to strengthen that Navy in every class of fighting vessel. Of all the descriptions of fighting-ships—though we can afford to neglect none at the present time—I believe that which it is most important to add to our shipbuilding programme is the sea-keeping torpedo-boat. We have ironclads, we have fast cruizers, we have the larger torpedo-vessel of the "Archer" type represented in considerable numbers in the last shipbuilding programme which was presented to Parliament, and I venture to hope that in the shipbuilding programme which we shall shortly be called upon to consider in Parliament we shall find a large development given to sea-keeping torpedo-boats. When I had the advantage of accompanying Admiral Hornby in the cruize of the Evolutionary Squadron last year on the coast of Ireland, I was very sensible—as anybody must have been who was present—of the inefficiency in point of dimensions of the boats which accompanied that squadron. They were valuable, no doubt, for operations within easy reach of harbours, but they were certainly not sufficiently powerful to contend with the open ocean, and when on a later occasion—a very late occasion—I saw Lord John Hay preparing to go to sea from Malta to the rendezvous at Suda Bay, it certainly seemed to me that if it was recognized as essential that the Fleet should be attended by torpedo-vessels, the three first-class torpedo-boats of a very early type, which were to accompany that fleet, were not of a sea-keeping character, and that it behoved those who are responsible for the administration of the Navy to lose no time in adding to our naval resources a very considerable number of torpedo-vessels, in model very much resembling torpedo-boats which we now have, but considerably larger in the point of dimensions. I hope that those boats will be found occupying an important space in the programme which will very shortly be submitted to Parliament.

Mr. Beazeley: If I may be allowed as a visitor and a civil engineer to make one or two remarks on Admiral Fremantle's extremely interesting lecture, I should like to claim the priority of invention of his excellent boat-lowering apparatus for the late Mr. John Wright, Engineer. Mr. Wright was extremely well known in the profession as a civil engineer, and thirty years ago, when I had the advantage of being a pupil of his, he described, at the President's Conversazione, in Great George Street, in May, 1856, the model of his boat-lowering apparatus. As one of his pupils, I had the charge of exhibiting it to those who were present, and it was precisely in detail the same thing that Admiral Fremantle has shown us to-day. The davits were curved, and they were hinged down the sides of the ship. It excited a good deal of attention at the conversazione, but probably did not go further owing to its having been shown at a purely civil, and not at a naval exhibition. I should like to make some remarks with regard to Admiral Fremantle's description of the operations in the River Min, in August, 1884, against the Chinese Fleet; and without trenching on politics, or on dangerous topics, I may say that although I was not present on the Min at the time, I was resident at the neighbouring port of Amoy, and had been so for several years past in the service of the Chinese Government—not in either of the military services, but in the peaceful occupation of lighting the coast of the southern part of China. I am extremely well acquainted with the River Min, as I have no doubt is the case with many Officers present who have been on the China Station, and I can only say this, that if the Chinese Government had been furnished with a proper torpedo apparatus, especially with the Whitehead torpedo that Admiral Fremantle has so justly praised, not one of those French vessels ought ever to have got down the river again. Anybody acquainted with the Min up to Pagoda Anchorage, where this destruction of Chinese vessels took place, must be aware that with the slightest, the most rudimentary, attempt at torpedo service, every one of those French vessels would have been destroyed. Without entering on dangerous topics I may say, Sir,

that since the massacre at Sinope, I cannot remember anything more horrible than that affair was. Those who have been on the China Station must know what those fifteen vessels were that were sunk and destroyed. They were merely small wooden arsenal gunboats, with one exception, which was a training ship. By a strange irony of fate they were built at the Foochow Arsenal under the superintendence and entirely under the direction of French authorities. These fifteen small helpless wooden vessels and their unfortunate crews were sunk by the powerful French iron-clad fleet; and this naval victory, which was made so much of in the French papers, was simply a cowardly and most brutal massacre.

Captain CURTIS: With regard to the lowering of boats at sea, it seems to me that the great danger arises from the ship's rolling and thus there is fear of staving the boat. The arrangement suggested by Admiral Fremantle seems to me to be very good, with the exception that you want a spur to keep the boat clear of the ship. With respect to ironclads, I look upon them as bearing the same relation to the Navy as siege-guns do to the Army. No one would think of moving siege-guns without some protection or support, and therefore I think it is quite right that ironclads should be supported by torpedo-boats in blockading or sealing an enemy's ports and otherwise. Looking at our distant Colonies, it becomes very essential that we should be able to move these floating fortresses to far-distant lands thousands of miles off. Our present torpedo-boats and small cruizers, also ocean cruizers, are not vessels adapted for sealing ports or protecting arsenals and commercial ports. Then with respect to the nets: Admiral Fremantle says the depôt ships will supply nets to the Fleet. I mentioned the other day when we were discussing Mr. Nordenfelt's lecture that I thought, in all probability, vessels carrying spars and so forth would accompany the Fleet, and working parties would lay out the booms and gear in order to protect the blockading fleet. Moreover, the nets would act as a breakwater. A net off Cowes in the Isle of Wight did act and break the sea, some few years ago. Moreover, with respect to steering gear, the efficiency of manœuvring the Fleet will in a very great measure depend upon the efficiency of the manœuvring and steering power of ships.[1] Without mentioning the names of ships, "if it is true," as we have read of late, that some of them are very defective in steering, I think it would be a very good thing if a Committee of naval experts were appointed to report on the subject.

Colonel HOPE, V.C.: As apparently there are no other naval Officers inclined to take part in the discussion, I beg to say a few words, though with great diffidence, in the presence of so many very distinguished sailors, being myself one of those helpless persons known in the Navy as "soldier Officers." I have listened with great pleasure to the Admiral's remarks as to the real, proper, sober value of torpedo-boats, and I think that anyone who has seen something of warfare must come pretty much to the same conclusion,—that the risk to human life on board a torpedo-boat in broad daylight is so terrible that there will be the very greatest possible difficulty in getting crews, except, perhaps, on the first occasion. I have also listened with great pleasure to the few isolated remarks which he made with regard to guns, of which he appears to entertain a very high opinion, and I only rise for the purpose of telling him and those present that I hope to have a gun ready for public trial about the 1st May; I will announce it in the "Times," and I shall be very happy to see anyone who wishes to come to the trial. It will be the first of six guns that I am making for a foreign Government. These guns will have a velocity of 4,500 feet per second; and that not with a light shot, but with a shot of double the ordinary length and weight. That evidently introduces a new feature into naval tactics. The first gun, which will be a small one—I have an order for four of them, and two large ones—is a 2½-inch gun, throwing a 12-lb. shell with 19 lbs. of powder; the two larger guns are 5-inch guns, throwing a 95-lb. shell with 151 lbs. of powder. The 2½-inch 12-pr. will be able to sink a torpedo-boat almost, if not quite, on the horizon line, and the penetration at 1,000 yards will be about

[1] It would appear that some ships are very deficient in steering, and are not only a source of danger to themselves, but to others accompanying them.—J. D. C.

13 inches of standard wrought iron. The 5-inch gun, weighing about 8¾ tons, will have the same penetration as the gun which has been so long hatching, but which is not yet completed, at Woolwich, which used to be called a 63-ton gun, then 64, and now 68-ton.

Captain P. H. COLOMB, R.N.: I did not intend to have risen, as the hour is rather late, but I do not think it would be quite right for me not to express the feelings with which I have listened to my old friend Admiral Fremantle's paper. I have been very much struck with its moderation, and with the way in which the Admiral has balanced point against point, so that no one amongst us can say that he has "run away with an idea." And he has, I may say, completely filled his paper with thoughts which are of a momentous character. I do not propose to go into criticism upon the paper, but merely to say this, that with by far the greater part of what he has said I feel myself in complete concurrence. I must, however, differ from him on one point, which was referred to in the form of a question by Captain Bridge, that is, as to the proportionate numbers of small craft which would be necessary to accompany a fleet of ironclads. My impression is that the numbers, when you come to examine them more closely, would not be so large. I ought to say also, in reply to a remark of Captain Bethell's, that I am not sure at all that the general feeling in the Navy has been that it is necessary to have small vessels for the protection of ironclads. I rather think that the feeling of the Navy has been that the object of the small vessels is to make the attack—not to protect their friends but to damage their enemies. I think it is held generally—I am not going to say whether it is right or wrong—but I think it is held generally that given modern ironclads with a sufficiency of small guns, of quick-firing and machine-guns, and given nets or other suitable protection from torpedo-boats and vessels, and they are considered in the Navy generally to be well able to take care of themselves. I quite agree with what fell from Sir Thomas Brassey in reference to the policy of building these sea-keeping torpedo-vessels, and I have no doubt whatever that that policy will be continued. A remark was made—I think by Captain Hammill—to the effect that we could not revert satisfactorily to the tactics of a former age in view of preparing the tactics of the future. I do not quite agree with that. I think that you must look back to the tactics of a former age as the only foundation on which you can prepare your future tactics. Of course you may use history or you may misuse it, but I think if you study carefully the tactics of a past age, they will guide you to the fundamental principles which must govern the tactics of a future age. I think the lecturer has brought out that point, following up with greater elaboration the idea with which he credited me for having started some years ago, and that is the doubling upon a ship. In old days the attempt was to double by placing two ships in such a position as to present a greater force upon one ship. That has passed away now, because fleets will fight at considerable speed. The doubling now is that two or more ships should pass one ship and give her broadside after broadside, or torpedo after torpedo, and thus double upon her in succession, and not in position. Now, if you followed the historical method, and attempted to place your ships now in the form of doubling in position, you would be wrong, but the idea of doubling is simply changed from the old tactics and applied to the new, and in that way I think you can always use the history of the past to guide your steps in the future.

Admiral FREMANTLE, in reply, said: Captain Bethell in his remarks said that the tendency of the future would naturally be to decrease the size of the ironclads. I think if he refers to a lecture which was delivered here not very long ago by Sir Edward Reed, he will find that Lieutenant Tupper gave a description of what he thought would be a very proper ship. He enumerated all the things which were to be put into her, and then he said that the ship must not be too large. Sir Edward Reed took him up directly, and said, "This is all very fine; it is exactly what the naval Officers are always asking for. They want this and that; they want a fast ship; they want a ship to carry big guns; they want a ship fitted in every possible way, and then they say, 'Don't make her too large.'" I agree that we do not want a ship to be too large, but then if we come to look at it from the naval architect's point of view I think we shall find it extremely hard to point out exactly where we

should wish the line to be drawn, and what we are going to give up. If we are satisfied to give up speed, like Admiral Elliot, we may come to a point which we may think satisfactory. I think it is not satisfactory to sacrifice speed. But we must give up something. It is only a question of detail, but I must say that my sympathies are rather with the naval architect in that matter. Captain Brand made a very fair criticism upon the name of the lecture. I do not think we do know quite what naval tactics are, and I am bound to confess that perhaps it would have been better to have called my lecture "Naval Warfare." My excuse is that I was asked whether I would give a lecture, and whether it should be on the 19th of February, and I thought "Naval Tactics" covered the ground pretty fully. Certainly I meant to deal generally with the questions of the day—the question of torpedo-boats especially; but I think "Naval Warfare" would have been a much better name. As regards groups, it is a very difficult subject, and a very technical subject, and one into which I do not care to enter at this moment; but I think when Captain Brand spoke in favour of groups, he said he meant generally a group of two. That is a very different matter. The group of three is a thing I object to, as not being usually practical or efficient, though it may appear to be clever. What I call "a trap for the unwary" is a group in the form of a scalene triangle of very curious shape. The ships are to keep their position in a very curious way, and everybody knows that you have got to a very funny state of affairs in the Signal Book through that sort of group. You tell them that when they are to alter course in succession, they are to alter course together. Altering course in succession we understand it, is follow-my-leader; altering course together is right or left turn at once. Now, when you have come to the farce of telling these ships when they are in a group that because they are in a group when they are told to alter course in succession they are to alter course together, I think that it shows the difficulty that we have been driven to. I think Captain Colomb had a great deal to do with the Signal Book, and we may be sure that he felt driven by the logic of facts to put ships into that position, and if so I do not consider that it is very practical. But I will reconsider my views if any Admiral will tell me that it is practical. I agree that there are advantages in a group, if two ships are to be called a group, but I think it is clearer to call them a subdivision, and tell subdivisions to act independently, instead of talking some shibboleth about groups, and saying groups are to act independently. Captain Bridge asked a very proper question about the torpedo-boat, as to whether in the 100 sail which I mentioned the boats carried by the ships themselves were included. Certainly not. The fifty first-class torpedo-boats that I put down are of course not carried on the ships. I consider that the amount of small craft that would be required is very considerable, and my ideal fleet I calculated would cost a little over thirteen millions of money. Perhaps that is a great deal too much; possibly we should have only six ironclads in the fleet, and in that case the cost would be only six millions. I do not wish that to be taken at all as my idea of what necessarily would be a fleet, but if you assume that you are to have twelve ironclads I am rather inclined to assume that you ought to have all those small craft to protect them, and to assist them to counteract the enemy's small craft. I may perhaps point out that in 1883 our import and export trade amounted to 731 millions, and that is a very large amount to protect. In 1884, although it had somewhat decreased, it still was 685 millions. Captain Hammill's question with reference to comparing future naval tactics with the tactics of a past day has been so well answered by Captain Colomb in so much better language than I can command, that I really have nothing to add except to say that I am much obliged to Captain Colomb for having put it so clearly and so eloquently. As regards the naval war game, I quite agree with Captain Hammill. I think I have fought two games, but that is about all. I bought the block, and intended to go at it. In one ship we had, as I say, two or three games. I am very sorry that it has not been more adopted in the Navy. It certainly was extremely useful. It gave you certain rules which were of great service, and it also afforded some general information as to the tactics of a gun and torpedo action between a couple of ships. I quite understand what Sir Thomas Brassey mentioned about the arm of the feeble. He was talking about torpedo-boats for harbour defence,

but there is a general idea that by some invention or other you will be able to have cheap methods of warfare, which I object to. Mr. Nordenfelt, for instance, says that his submarine boat is very cheap. He says, "I can build this for so many thousand pounds, and I can blow you up a ship which cost a hundred times as much;" but when you come to multiply these torpedo or diving-boats, you find that they are no longer the arm of the feeble, and when you come to have fifty of them, you will see that they cost a good deal. I have shown that we have 130 torpedo-boats, so that they are already in existence in large force, and I find that the fifty torpedo-boats in my ideal fleet would cost about 750,000*l*. As an instance of what I mean, M. Gabriel Charmes seems to have talked a good deal about the easy way in which he could destroy the British Navy, and amongst other things he was going to have some magnificent cruizers which would go about 25 knots, and which he put down as costing "not less than 80,000*l*." Now our 19-knot American liners, the "Umbria" and "Etruria," which nearly approach M. Charmes' ideal, cost 325,000*l*. each! Of course this shows how very easy it is to talk about a very cheap thing until you come to order it; but when you come to order it and want to get it, you find you cannot do it quite so cheaply. I think it is a satisfaction to us to know that we have the money to a certain extent to do these things, but at all events it is very easy to talk about having cheap torpedo-boats. That was the reason why I mentioned the question of the arm of the feeble, because I think it is wrong to speak of it as a cheap thing to have torpedo-boats. I am afraid it is not cheap, and the fact is that all these inventions cost money. With regard to what was said about the River Min operations, I have nothing to say as to the illegality of those operations or their inhumanity, or any questions of that nature, but I must repeat that, having read the French report, I thoroughly believe they were carried out skilfully, and that we have something to learn from them. I think it right to mention, as regards the torpedoes which they used, that they were used from two steel torpedo-boats, which simply ran out and deposited their torpedoes under the Chinese sterns before the Chinese fired a shot. Of course that does not prove very much in favour of the torpedoes. I think they had some Whiteheads in one of the ships afterwards, but they never certainly fired a shot. Sir Cooper Key says they had none. With regard to the boat-lowering apparatus which Captain Curtis criticized, I am much obliged to him for his criticism, but I may say that this model is not complete. The spur is very much what we have for hauling out the davits in the paddle-box boat. I do not put it forward as an invention, but I wish that something could be done for getting our torpedo-boats into the water, and I am sure that anyone who has had experience in getting them out of a turret-ship with one derrick, gingering them in and out inside the rigging and outside the rigging, stopping the derrick, and hoisting the boats, and so on, will understand that it is a perfectly unpractical plan of attempting to get your boats out at sea even in fine weather. With regard to the speed of the ships, I should say they should go about 12 knots. I am very glad that Colonel Hope approves of the gun. Of course Colonel Hope is a great authority on the gun question. My own impression is that the last word has certainly not been said on the part of the gun, and that one reason why the torpedo-boat has had so much in its favour is that it is ahead of the gun to a certain extent, as I have pointed out in the lecture. I am very much obliged to Captain Colomb for the extremely complimentary way in which he was good enough to speak of my lecture. I am sure he will appreciate how difficult it is to deal with a subject of this sort, which is a very large subject, and how everybody will say, "Why, he has not touched upon that particular subject which is of great importance." I venture to think that I tried to take the most important point, and to deal principally with that. If therefore I have failed in dealing with certain parts of my subject, I must ask you to excuse me, but really what I did intend to do was to deal with the question of torpedo-boats and torpedo-catchers. I beg to thank all the speakers for the exceedingly kind way in which they have spoken of the lecture generally, and I only wish it had been a better one.

The CHAIRMAN: I have now the pleasing duty of asking you to allow me to

return your thanks to Admiral Fremantle for his interesting lecture on very important subjects. I am not here either to air my own opinions, or to discuss the many questions that have been brought before us. I am simply here as your spokesman, and I am glad that I cannot be expected to go fully into all the questions that have been raised to-day. Captain Bethell made some interesting remarks, with which I agree, that it is for us to consider whether the days of ironclads are passing away. I do not say that such a change is imminent, or that in my time we shall see it; but I am satisfied that we shall have to look forward to it before very long. It is highly improbable that torpedo-boats will take the place of ironclads. Captain Bethell remarked that if two fleets of ironclads are engaged, and that each has a squadron of torpedo-boats protecting them, you might gain an advantage by sending your ironclads away, but replacing them by another squadron of torpedo-boats, you would be very much stronger. To carry out the same principle you might say that you would be still stronger if you had no ships at all, because that would be the next step to take; having sent your ships away, send your torpedo-boats away, and then you cannot be hurt. But without squadrons and large numbers of seagoing ships, how are we to protect our Colonies and commerce? We must have a vast number of large ships and small ships; torpedo-boats will take their place as auxiliaries. I am glad to learn, from the remarks Admiral Fremantle has made, that he does not look forward to our naval power being threatened by the introduction of torpedo-boats. What we have to do is to look round us and prepare to meet the attacks of torpedo-boats, and be satisfied that whatever number of light vessels or torpedo-boats other nations build for themselves, we must treble or quadruple it. No maritime nation in the world has such power to turn out small vessels, whether torpedo-boats, fast cruizers, or protected cruizers, so rapidly as we can, if we choose to see the necessity for it, which I believe now exists. It is a vague theoretical idea entertained by some people that our naval power is threatened by the introduction of torpedo-boats. What we have to do is to meet one by three, and that is what we must certainly do. Captain Colomb has somewhat forestalled me in the remarks I should have made on this admirable lecture in saying that Admiral Fremantle has put every point forward in such a moderate way, he has not put forward prominently any particular fad or pet whim, which is usually our weakness. I think the lecture is both interesting and instructive, showing an intimate knowledge of what other Powers are doing. Every question has been put reasonably before us. I do not think that Captain Colomb, in answering Captain Hammill's remarks, brought out quite clearly what Admiral Fremantle intended to say. No doubt the study of naval warfare of former days teaches us the principles on which naval tactics should be invariably founded, but only the principles. As regards naval tactics of the future, I think they are "all in the air," but those elementary principles, founded on courage, presence of mind, rapid decision as to the best means of bringing a superior force quickly to bear on an inferior force—those principles remain to all eternity; but they do not include the science of naval tactics. With Captain Hammill I looked forward with some anxiety to see what direction a paper headed "Naval Tactics" would take, because such a subject is open to a discussion of the wildest character with our little experience of the engagement of hostile steam fleets. I think Admiral Fremantle deserves our applause for having produced a paper which gives us so much room for thought. I might, without touching on tactics, say one word about groups. I think both Captain Brand and Admiral Fremantle hardly referred to the real importance of the use of groups. I look upon their principal advantage as this. Call them pelotons or subdivisions, if you like, but I think an Admiral should organize his fleet so as to be able to form them into subdivisions of three ships. He has then a power of selecting Officers for the command of each group or small squadron or subdivision, and knowing that when the original formation of the fleet is broken up, which it certainly will be in a general action, he has in each subdivision three ships that will stick together under a good Officer, and that that man will take care when opportunity offers, as Nelson did at St. Vincent, to bring his little subdivision to bear where it is most wanted, only, of course, when he loses touch of his Admiral. I think that is the advantage of it. But I say

also that I do not think it is a comfortable thing, manœuvring in groups, formed, as is usual, in a scalene triangle. The advantage of that formation is for fighting only, and that by a touch of your helm you can bring these three ships in line ahead, and then again by a touch of the helm you can re-form them into groups. You can thus manœuvre those ships in the simple formation of subdivisions in line ahead, and when you are going to engage throw them into groups instantly, which will clear your broadside and bow fire. But I would not manœuvre my groups, because I believe it will be found that manœuvring in a scalene triangle with inexperienced Captains, who have not been accustomed to work together, will lead to confusion. At this late hour I will simply ask you to allow me to tender Admiral Fremantle your thanks for his admirable and interesting paper.

G

INF

P

OUT
Suak
to Se
discu
I cou
Th
impe
para
Arab
unsec
Ac
you
agai
of lo
agai
that
of fi
long-
Soud
alwa
separ
broke
separ
This
briga
resul
At
squar
endor
it be
bound
prote

Friday, February 26, 1886.

GENERAL THE RIGHT HONOURABLE VISCOUNT WOLSELEY, K.T., G.C.B., G.C.M.G., &c., &c., in the Chair.

INFANTRY FIRE TACTICS: ATTACK FORMATIONS AND SQUARES.

By Lieut.-General Sir GERALD GRAHAM, V.C., G.C.M.G., K.C.B.

OUT of respect for the force I had the honour to command in the recent Suakin Campaign, I propose to take square formations first, as applied to Soudan warfare; a subject that was ably though not exhaustively discussed in a lecture delivered in this theatre in June last year, when I could not attend.[1]

The real reason for our adopting square formations was the dense impenetrable[2] character of the belts of bush in the desert which paralyzed effective cavalry action, while allowing the fearless active Arabs, who move with all the rapidity of cavalry, to approach unseen.

According to the best authorities squares are only to be used when you cannot protect your flanks and rear by any other formation against an enemy who employs shock-tactics; therefore, in these days of long-ranging arms of precision, squares should rarely be used against cavalry, as that arm requires open country to charge over, so that the best defence for infantry would be as complete a development of fire as possible. Thick bush of course neutralizes the advantage of long-range aimed fire, and with a rapid daring enemy like the Soudanese, compels the troops to maintain a formation which will always protect their flanks and rear. The objection to having separate bodies in échelon, either in line or square, in bush or broken ground, where the enemy can get in between, is that the separated portions of the troops are liable to fire into one another. This actually happened at Tamai in March, 1884, when the two brigades were in separate formations, but happily without serious results.

At the meeting I have referred to in June last, the objections to squares, as a fighting formation, were well stated and will be heartily endorsed by all who have had anything to do with them. Nor must it be supposed that in our fights near Suakin we were slavishly bound to the square as a fighting formation. The necessity for protecting our large convoys obliged us to employ it on the march

[1] *Vide* the Journal, No. CXXXI, page 887, *et seq.*
[2] The word "almost" was inadvertently admitted.

through the bush. Nevertheless, as the lecturer fairly stated, the battle of El Teb, in 1884, was fought in two lines; and I can add that, in the following battle of Tamai, the second brigade was, after its retirement, brought up in line to recover the naval guns, one battalion being in open column on the left, and the right flank being supported by the first brigade in square. Again at Hasheen on the 20th of March, 1885, the Dihilbat Hill, held by the enemy, was stormed by the Berkshire in attack formation supported by the Royal Marines; and, at Tamai, on the following 1st of April, the advanced brigade had one battalion deployed in line, with a battalion on either flank in column. The heights were afterwards crowned in line, and it was not our fault that there was so little fighting on that occasion. On our march out through the bush we had not less than 340 horses, 740 mules, and 1,670 camels to take care of, besides guns, ambulance wagons, carts, stretcher detachments with numerous native followers, drivers, &c. If anyone can inform me how such a mass of transport and non-combatant followers could have been protected in a march through the bush in presence of an enemy who had repeatedly proved themselves capable of charging against any odds and of doing immense injury to the transport, otherwise than by placing troops all round them, I shall feel much obliged.

A critic of the square formation in "Blackwood's Magazine" of May, 1884, makes a most disparaging comparison between our performance at Tamai, in March, 1884, and that of the troops under Sir Charles Napier at Meeanee, in February, 1843.

That great soldier certainly did wonders with his small force, but notwithstanding the marvellous disproportion of numbers, I venture to assert that Sir Charles Napier had not nearly so formidable an enemy to deal with at Meeanee as we had at Tamai.

The Beloochees, estimated as 36,000 strong with 18 guns, occupied the bed of the Fullaillee River along a front of 1,200 yards, the high bank serving them as a rampart. Finding a flank attack impossible, Sir Charles Napier (leaving 400 men as a baggage guard) boldly attacked this position in front with about 2,000 men (of whom only 500 were Europeans) and 12 guns. His formation for attack was a very bold one, as he had no reserve (unless the baggage guard can be considered a reserve), but his advance in échelon of battalion lines, with the European troops leading, was the best possible disposition of his force. He was advancing against an enemy in position armed with matchlocks and having 18 guns, so that line formation was of course that in which he would suffer least loss, while to make the most of his small force he wanted as great a development of fire as possible. Yet it is evident from what took place after the battle that Sir Charles Napier would not have adopted this formation had not both his flanks been protected by the high walls of Shikargahs,[1] and by ground impassable for cavalry. The Shikargah on his right flank had a gap which he closed with a company of the 22nd, who defeated an attempt at a counterstoke by the Beloochees. With this exception the Ameer's

[1] Shikargah, a walled-in hunting ground.—Ed.

forces seem to have had no idea of advancing beyond the river bank, behind which they crowded and were shot down until finally dispersed by a charge of cavalry. In concluding his stirring account of this brilliant victory, Sir William Napier writes:—

"All were now in retreat, but so doggedly did they move and seemed so inclined to renew the conflict on the level ground, where the British flanks were unprotected, that the General (Sir Charles Napier) unwilling to provoke a second trial, recalled his cavalry and formed a large square, placing his baggage and followers in the centre." Sir Charles Napier was too good a soldier to have advanced in line with his flanks unprotected or to despise the square as a defensive formation, even against a beaten enemy. As regards the actual fighting at Meeanee the best and most unimpeachable testimony is that of General M'Murdo, then a subaltern of the 22nd Regiment, a cool and observant eye-witness, and in that very interesting memoir of Sir Charles Napier by Mr. William Napier Bruce—General M'Murdo writes as follows:—

"The behaviour of our men (22nd) when they charged to the edge of the bank of the Fullaillee surprised me exceedingly; but as the fighting went on, I saw they had judged rightly, and their example was implicitly followed by the native regiment on their left. The line recoiled some six or eight paces, and then remained deaf to all orders and entreaties to renew the charge; the men advancing only to deliver their fire into the thick masses of the enemy in the river bed, and returning to load; this mode of fighting was continued for the greater part of one hour. The behaviour of the Beloochees was equally strange and unexpected; but perhaps equally natural under the circumstances. Their fire, beaten down in volume by a rolling musketry, was only sustained in a desultory manner. They could not make any impression upon our line, beyond forcing it back a few paces. They could not retreat, because they were pressed upon from behind by the masses of which they formed the front rank. Driven desperate by the unceasing musketry, the masses frequently charged with sword and shield over the bank; but as these rushes were not made in concert along their line, our men were able to lap round their flanks, and hurl them back over the edge."

General M'Murdo also records seeing in the midst of the action about 10 per cent. of the men in the fighting line engaged constantly with the locks of their muskets, either in wiping moisture from the pan, or in chipping their blunted flints; and states "I saw some even change them (the flints) for new ones . . . the men did not fall out to the rear, as on parade, but stood their ground in line with their bayonet points to the enemy." To enable them to do this so leisurely the enemy must have left them tolerably unmolested. At all events their mode of fighting must have been very different to that of the Arabs who made such desperate charges on our squares at Tamai.

Sir Charles Napier's attack on the Ameer's forces at Meeanee, despite their numbers, was at once prudent and magnificently audacious, as, had he delayed it, their strength and confidence would have greatly increased. Nor could anything have been finer than the leading and conduct of his troops. But, in reply to the Blackwood reviewer, I assert that it is most unfair to our soldiers who fought so gallantly at Tamai to compare these half-hearted followers of the Ameers with the desperate fanatics of the Mahdi, whose great desire

was to get killed after slaying an enemy; and to argue that because échelon formation was effective against Beloochees in the plains of Scinde, it should have been employed against the Hadendowas in the dense bush of the Soudan desert.

But we must be prepared for other enemies than the brave Soudanese, for an enemy armed like ourselves and trained in the school of modern warfare.

The subjects of fire tactics and attack formations (especially the latter) have often been discussed in this Institution, but they can never be worn out, and always present new features as we bring fresh experience to bear upon them.

In the following observations, I trust I shall be considered as rather desirous of eliciting opinions from Officers of greater experience and knowledge than I possess, and from others who have thought and read about what to us all are subjects of high importance and interest, than as attempting to lay down any theory of my own. indeed, I may commence by stating that I have nothing new to bring forward about fire tactics and attack formations, nothing that will not be familiar to those who have studied the subject.

As we all know, our army exists under very different conditions to those which apply to the vast forces of the Continental Powers. Ours is a volunteer army, service in which should be made attractive, so that the training must not be too severe.[1] It is also an army that has to serve in all parts of the world and to fight against all manner of enemies, so that there is much greater difficulty in carrying out a complete course and system of training than in armies which are kept at home, and only engage in great wars.

On the other hand, we may derive consolation in calling to mind the material out of which we have to form an army, by remembering, in proposing a system of training for our troops, that our soldiers still possess the same qualities of courage, coolness, and self-reliance which enabled them at the Alma, as before in the Peninsula, to meet and repulse in line the massive columns of their enemies.

"It is essential that it should be clearly understood," wrote Home, in 1873, "that the British army with its historic training, and traditions of advancing and fighting never more than two deep, possesses qualifications for modern fighting that the army of no other nation in the world does."

But an army must beware of counting too much on past glories. No troops ever had a more glorious history of victory gained against great odds than the Prussian armies that were crushed on the same day at Jena and Auerstadt, and yet they were of the same stuff and trained in the same school as those who had won the battle of Rossbach against the same enemy. The collapse of the Prussian military power before that of France at the beginning of the century is indeed one of the marvels of history. It seems scarcely credible that the magnificent army which the Great Frederick led, in 1778, to the second invasion of Bohemia should, only fourteen years later,

[1] "The Prussian recruits work like niggers."—BARON STOFFEL.

have to retire in disorder before the raw French levies at Valmy; and that another fourteen years should witness that crowning disaster, within sight of Rossbach, which laid the Prussian Monarchy helpless at the feet of Napoleon. It was in the stern school of disaster and suffering that the foundation was laid of Prussia's greatness, when Stein and Scharnhorst patiently laboured and bided their time. The army of Prussia is a noble monument of a people's patriotism wisely directed, steadily and unremittingly worked at, in prosperity as in adversity.

The present leaders of the German Army are wiser than those who succeeded the Great Frederick, and are not satisfied to rest on their laurels, as is evident by their ceaseless, thoughtful, vigilance in correcting defects and adopting improvements, so as to maintain that great Army in the highest state of efficiency. It is for us to recognize to the full the teaching conveyed by the past history of our own and other armies, and not to assume that it is less incumbent on us than on our neighbours to train our soldiers to meet the requirements of modern warfare. We, happily, have not experienced the disaster—the shame and agony—of seeing our homes invaded and laid waste by a conqueror, or we, too, might take up military reforms in earnest, as the Prussians did. As it is, military reformers, especially if belonging to the Service, are looked on with suspicion as probably only wanting to improve their own position, and as being regardless of spending the people's money. Whatever the cause may be, we certainly are not prompt or earnest in modelling our Army in accordance with the progressive changes in warfare. A German writer,[1] in enumerating the various changes other nations immediately adopted in their Army organization and tactics in consequence of the events of 1870 and 1871, observes: "Only England persisted in her old Army system, relying on her geographical position."

It is too true that we as a nation do rely overmuch on having water all round us and on our splendid naval victories of former days, so that we are apt to treat as mere alarmists those who point out that we may one day have to fight for our national existence upon our own soil. Independently, however, of all possible chance of invasion, the time may come when we shall have to measure our strength with that of one of the great Continental Powers, and it behoves us to consider whether the force we shall have available will be at its highest attainable efficiency, and if not, what steps should be taken to reach that point.

One great lesson for us to learn from the Franco-German War is the transcendent importance of the individual training of the soldier under his Officers, with consequent fire-discipline and knowledge of the tactical use of his arm. The German infantry had a weapon inferior to that of the French, and at the commencement of the war their tactical formations were very faulty, but everything was redeemed by the fine spirit and discipline of Officers and men, which made them always push forward to the sound of the cannon, and which enabled them to reserve the greatest energy of their fire for the decisive phase of the action.

[1] Colonel von Boguslawski.

Under the old Prussian system of Frederick the Great, on which our close order drill is still based, the men were mere component parts of a machine trained to work under the hands of their commander with perfect order and precision, their courage and training being shown by moving under fire as if on parade.

A fighting unit is now no longer to be considered as a machine but rather as an organism, each atom of which has its individual life and energy, and men must now be trained to a higher standard of discipline and self-reliance than formerly.

When fighting in extended order, groups will frequently be deprived of their leaders, and it will be easier for a man to evade a difficult or dangerous duty when not under the eye of his Officer than when forming one of a close body. Special organization and trained self-restraint is required to give a soldier good fire-discipline in the heat of action, and trained intelligence to enable him to take advantage of the ground. In the German Service this training is carried on in companies and battalions under a system that leaves great independence of judgment and individual initiative to the Officers. There is a very interesting report by Baron Kaulbars, of the Prussian Service, on the German Army in 1876, translated by Colonel Sir Lumley Graham, in No. CIX of the Journal of this Institution. It is too long to be quoted here, but in it it is stated that the commanders of companies have the entire responsibility for the training of their men, the only check upon them being occasional inspections. "The commander of the battalion is not allowed to interfere with the instruction of the companies. Later on he will in his turn take his battalion in hand, and will then become entirely responsible for its tactical instruction." Such a system is well calculated to make Officers and men take a strong interest in their work; and avoid stagnation over routine duties by promoting a healthy emulation among Officers of all grades.

As regards the training required for the men, a very distinguished Officer of the German Army writes as follows:—

"The individual action of skirmishers in the firing-line will be on all occasions the most important part of the infantry soldier's fighting, and the army which learns best how to train the individual foot soldier to make the most of his firearms, and at the same time to act upon the signs, the orders, and the example of his leaders, will gain a decided preponderance in war. For of what use is action, however vigorous, unless directed with good judgment upon the decisive point? In this consists the difficulty of military training. The men must be accustomed, through fighting in extended order, to obey the commands of their Officers and to maintain perfect discipline. This combination of discipline with individual initiative was the great secret of the superiority of our infantry in 1870–71, and will surely give the preponderance to any infantry over another inferior to it in that respect. This fact has been recognized by our authorities and is the motive for all the alterations to be found in the Infantry Field Exercise Book of 1876. The alterations thus made prove that those at the head of our Army gathered from the experience of the last war, successful as it was, the necessity for tactical improvements, thereby admitting the previous existence of imperfections. This admission entails no shame on those who made it, but is on the contrary highly creditable to them."[1]

---

[1] Prince Hohenlohe on Infantry, translated by Colonel Sir Lumley Graham. "Journal Royal United Service Institution," No. CXXX, page 745, *et seq.*

To this is appended a footnote by the translator, with which we must all fully concur:—"The conduct first of the Prussian Army, afterwards of the German Army, in constantly seeking to surpass itself, is one of the most noteworthy points in the military history of the nation. Most armies after such unparalleled successes would have gone to sleep and rested on their laurels."

Speaking at this Institution in 1884, Lord Wolseley said:—

"I cannot help thinking that nearly all the armies of the world, certainly our own, have always reversed the order in which drill ought to be taught. Our notions as to what a battle ought to be seem to have come down to us from prehistoric times almost. We then apparently set to work to create a system of drill to meet the circumstances and exigencies of this imaginary battle. My view of drill would be exactly the reverse of that process. I would first of all read the books written by others who have great experience of what has taken place, and what does take place, in every action. I would find out exactly what it is—what an action is—from the very first moment a shot is fired until the position on either side is stormed and taken. I would find that out; find out what the duties of a private soldier in action really are, and having thoroughly arrived at that conclusion, then work back from that to the goose step."

Acting on the principle thus clearly stated, is it not time we should recognize that the essential point in training our young soldiers is, that they should learn how to fight in extended order, and that we should therefore establish a system of drill, calculated to enable our Officers to turn men out fit for active service within the shortest possible period? At present we devote too much time to mere parade movements in close formation.

"The British infantry," writes one of our critics, "must rise to a higher conception of its functions and duties if it would not fall behind that of all Europe. The recruit must indeed be first trained in the barrack square to discipline of limb and mind, but that once done, he must be developed into the best possible fighting man. Drill is all very well as the alphabet of his work, but too much of it, unrelieved by higher training, kills that individuality which is above all things necessary to the fighting of to-day."

It is more true now than it was when Napoleon I wrote, "Fire is everything; the rest is but of small account." The instruction of the soldier in the proper use of his weapon under fire-discipline is the all-important part of his training. By looking at the conditions under which our soldiers will have to fight, we may endeavour to work back to the fire-training required on the principle sketched out by Lord Wolseley as regards drill.

We must then begin by considering the state of affairs when the fighting line of an attacking force has advanced to within 400 yards of the enemy's position and is hotly engaged. We have all read of, and some of us know from experience, the feeling of wild excitement that prevails among soldiers when in action at close quarters, when each man seems only to want to empty his cartridge pouch as rapidly as possible. This is often the result of uncontrolled fighting energy which, properly disciplined, leads to victory, but which without such restraint may bring about disaster. This is then the point we have to train up to, the ideal we have to try and reach; to evolve order out of disorder, and maintain control over the men in the most critical

moment of the battle, the moment when control is most needed, for that side which shows steadiest discipline and determination when it comes to close quarters, must win.

In a battle now-a-days fire-discipline must come first and foremost in importance. If men will not listen to their leader's orders to cease firing, they will certainly not listen to any other orders, and all power of direction will be taken out of the commander's hands. It becomes then a mere matter of impulse with the soldier, whether he rushes to the front under the spur of a brave enthusiasm, or to the rear under the influence of blind panic.

These are the words of General Skobeleff, and are applicable to troops employed against either a civilized or an uncivilized enemy:—"I cannot urge too strongly on commanders to have the fire of their men under control. . . He (each commander) must have his troops completely in hand at the critical moment of action, and they must be in his hands an instrument which serves him to impress with a supreme energy his thoughts, will, and feelings."

There are some admirable remarks on fire-discipline in the paper from which I have already quoted by Prince Hohenlohe, who writes with soldierly frankness, and although an artillery Officer, his remarks on infantry are well worth our attention.

"I have often remarked," he writes, "how much fire-discipline is weakened when the element of danger makes itself sensible. Troops imperfectly trained do not aim. do not even fire, they only let off their pieces. Even before I ever saw a shot fired, I was told by men experienced in war, that infantry soldiers must have attained to a certain degree of proficiency if they could be got to put their rifles to the shoulder when firing. At the battle of Königgrätz I had a very near view of troops (Austrian) keeping up a wild fire with their rifles pointed straight up in the air. . . . . How much more trouble is required before we can train the infantry soldier to pay attention to orders and signals during all the excitement of battle, to observe the object to be aimed at, the sight and mode of firing to be used, and to cease firing when the specified number of rounds has been expended? . . . . You are asking a great deal of a man who is being shot at when you tell him to cease firing for a while . . . . When firing once begins, men get easily out of hand, unless restrained by an iron discipline. . . . . It is but human nature that a soldier should derive some comfort from the noise made by his own gun when it goes off. The more raw the soldier the more will he be inclined to 'shoot himself into courage.' During the first campaign in which I took part I was present at a little outpost skirmish, after which the Lieutenant inspected the men's pouches. The older hands had only fired from three to five rounds each, while every recruit had got rid of over twenty."[1]

Fire-discipline requires special training and much practice in peace time. It will not do to assume that because a man moves with faultless precision on parade, or makes good practice at a fixed target, that he will be able to control himself so as to expend his cartridges with judgment in the excitement of action, or listen coolly to orders from his Officer under conditions entirely unlike those of his ordinary musketry practice. The conditions could indeed be scarcely more dissimilar than those of ordinary target practice and a battle-field. Let anyone visit the Wimbledon Camp on a fine July afternoon, and watch the perfect order and composure that prevails in that ad-

[1] No. CXXX, "Royal United Service Institution Journal."

mirably-organized shooting exhibition. He may perhaps notice a veteran champion who looks as if he were laying himself down for a comfortable nap, but whose piece presently goes off with good result at 1,000 yards. Can anything be more unlike the crashing roar, confusion, and excitement of a fighting-line when life is most intense in the presence of death, and when the strongest bonds of discipline and confidence in authority are necessary to draw men to listen for commands and to obey them?

What our soldiers require in peace-time is not long-range target practice (to qualify them as prize shots), but field practice with fire-discipline, to give them steadiness and confidence in battle. Years ago when we were fighting in the Crimea, most of our troops still armed with the old Brown Bess of the Peninsula, this question of fire-discipline presented itself to the minds of the thoughtful chiefs of the Prussian Army, already for some years in possession of the breech-loading needle-gun. Accordingly they instituted the system of "fire-units" or "groups," and so well has this organization (which has been greatly developed since 1870) been recognized as a potent element in the German victories, that it has been introduced into all the Continental armies.

There are generally sixteen of these sub-units in a German company, and in the German Infantry Drill Book (p. 39) it is laid down that each of them shall not exceed six or be less than four files, and thus in the fighting formation, which is in two ranks, the strength of a group would vary from twelve to eight men. It is further directed (p. 64), that:—

"In order to admit of the fire being controlled by the commander, the men of each section are to form a distinct group in the firing-line with several paces interval (in open ground) between each group; and this in order that the non-commissioned officers of the company, who are divided amongst the sections, may exert a proper and distinct control over their men."

Lieutenant Mayne, R.E., who has recently brought out a very able and comprehensve work on "Infantry Fire Tactics," is a strong advocate for the introduction of the group system into our Service. The following is an extract from this work:—

"The advantages which a firing-line divided into groups or commands has over a continuous firing-line, with each man working according to his own lights, are:—1. It enables a better control to be maintained of the men, so that they are kept better and longer in hand. 2. It enables a concentrated fire to be kept up even at the shorter ranges, and on the objects required to be fired at. 3. The pauses, so necessary to enable control to be kept up, are facilitated. 4. It conduces to a more rigorous execution of given orders. 5. It helps to avoid waste of ammunition, the group leader having the power of moderating the fire according to circumstances. 6. It permits of a more rational utilization of the cover given by the ground, and of a more energetic advance in the attack. 7. It gives to each man a contact with his comrades in the group, which increases his feeling of security and confidence by the moral protection it affords. 8. It presents to cavalry a series of organized groups quickly formed and capable of efficient resistance."[1]

The latest edition of the "German Musketry Regulations (1884)" shows how the standard of the soldier's training is always being

[1] "Infantry Fire Tactics," by Lieutenant Mayne, R.E.

raised as the requirements of war seem to demand. The following extract shows what great stress is laid on the training of the individual soldier: "Cases will occur in action when the company and zug leaders will no longer be able to control the firing. It will then be for the non-commissioned officers and intelligent energetic privates to use their influence on the men of the nearest groups, so that action may be regularly carried on. Under effective fire of the enemy at close range even this method of control must frequently fail, and the result will depend entirely on the individual action of the men. *Hence follows the necessity for so training and developing the individual soldier as to make him capable of working independently, and of making a proper use of his weapon without special directions in each case.*"

The group system is no doubt an admirable device for maintaining discipline in an extended line, especially in the earlier stages of the fight. The Germans do not however trust altogether to their group organization, but as the extract just quoted from their latest musketry instruction shows, they insist on "so training and developing the individual soldier as to make him capable of working independently and of making a proper use of his weapon without special directions in each case." This may be regarded as an impossible general standard of efficiency for all to attain to, and probably it is. What is really aimed at is to be found in the sentence immediately preceding that last quoted, viz., the training of the non-commissioned officers and intelligent privates so that they may be capable of taking the place of the group leaders who have fallen in the fighting-line. This is the backbone without which all mere system or organization will fail. For men to be under control and guidance in battle, there should be a sufficient number of reliable well-trained non-commissioned officers and brave intelligent men who will aid their Officers, or on occasion replace them. Captain Layman in writing of the training of infantry observes:—

"The group leaders are often a dangerous impediment. We imagine we can only keep the skirmishers in hand with their assistance. We therefore look upon the group as the lowest unit, and make too little use of the intelligence of individual men. They are accustomed to being led in leading-strings, for they have the group leaders who think for them. In an offensive engagement, however, after a few minutes there are no longer any decided groups. Here and there, in the vicissitudes of the action, new groups are formed, with which, however, there is not always a non-commissioned officer to take over the command. It then devolves of its own accord upon the most efficient man, whom the others in their need of guidance willingly follow. This may easily happen at a moment or at a point which is of decisive importance. If endeavours have been made to train the men by theory and practice for independence of action in the fight, then—provided that neither the brain nor the faculties required for the training are wanting, nor yet that the quality of the recruits stands too much in the way—a sufficient percentage of men will be found in every company who, both by their character and the development of their intelligence, will render essential aid in the proper conduct of the whole line of skirmishers."[1]

This was written very shortly after the war, and is in singular harmony with the latest views of the German authorities. They employ the group organization for the control and direction of fire,

[1] "The Frontal Attack of Infantry," translated by Major-General Newdigate.

giving at the same time the highest attainable individual training to the men so as to provide leaders or nuclei for the new groups when the old ones are dissolved or broken up.

This system of training the soldiers of the German Army seems at first sight to be contradictory, as it demands the strictest discipline together with the exercise of independent judgment. Yet it is based on actual experience in war, and appears designed to meet the unavoidable state of disorder and confusion in the crisis of battle, that time when control of fire can no longer be maintained by ordinary means—when many of the leaders are shot down and others are unable to make themselves heard—when even the groups are broken up or dissolved; then men turn instinctively to those nearest who are able and willing to lead or direct, and then is the time when previous training tells upon all, especially upon those who are able to keep their heads cool and impress those about them with confidence while inspiring them with their own daring. Such men cannot always be picked out in peace-time—they may not always be the smartest men on parade, nor the best conducted off it, they may be often quite unfit for promotion to the rank of non-commissioned officers, yet such men may exercise important sway in battle. In training soldiers to the use of independent judgment, it is not expected nor desired that every soldier should act independently. The majority of men, whether soldiers or civilians, only desire to be led, and by proper training the right men are given the knowledge requisite to enable them to lead aright. But only very good and careful training, and good material, could attain the result aimed at: "that each according to his station should understand how to combine independent judgment and action with due subordination to command."[1]

In our Service we are making a commencement at this sort of training, but it is, I think, much to be desired that we had schools for the education of our non-commissioned officers, such as are established in Germany with so much benefit to their army.

The group system cannot be said to be altogether unknown to us. It was employed by Sir Redvers Buller, for instance, in the Eastern Soudan in 1884, and I can certainly answer for the good fire-discipline of his brigade at Tamai. The "section" system in the "Field Exercises" is at least a recognition of the principle of controlling fire in action by the leaders of sub-units. But the group system is far from being generally recognized in our Service as it is in Continental Armies. Our small companies would greatly facilitate its introduction by enabling us to put each section under a sergeant, and when the section exceeds sixteen, each half-section under a corporal. The great object is to get these sergeants and corporals trained to lead and control their respective commands, and this can only be arrived at by constant practice in peace-time—on parade and in quarters. Our drill, even in close order, might with advantage be made to serve this purpose of training the section leaders by giving them habits of command with a sense of responsibility, and to those under them a habit of subordination.

[1] "Frontal Attack of Infantry."

We have introduced fire-pauses in our regulations as an effective means of controlling fire, but we have not yet got the machinery for obtaining these pauses, which may be called the touchstones of fire-discipline. We have yet to make it second nature for a man to look to his group leader for orders as to firing, and to pass the words of command when heard; experience also shows that we require a more powerful instrument than the human voice for communicating the order to cease firing in the heat of action. This is now done in the German Service by means of shrill-sounding whistles, as laid down by their latest musketry regulations. The commanders are no longer limited to ordering three rounds only in mass or volley firing, more liberty being given to their exercise of judgment. The leading principle of disciplined infantry fire is concentration in place of dispersion:—

"On the battle-field, the Germans, instead of letting ten men, choosing their own objects, fire eighty cartridges in four minutes on ten different objectives, prefer to concentrate, during half a minute, the fire of eighty men on the same objective, and then have a pause and open fire on the next one, and so on."[1]

Our regulations say—

"The fire must be slow enough to ensure accuracy. Pauses of some length should occasionally be made to allow the smoke to clear away, to judge of the effect produced, to give the necessary orders, and to keep the men steady."

As stated above, the Germans, and also the French, consider that these pauses should alternate with sudden rapid fire-action, so as to obtain a maximum effect in a minimum time.

The French regulations say—

"The suddenness of fire is one of the principal conditions of its efficacy. The moral influence of a material result is greater as this result is obtained in a shorter time."[2]

German writers also anticipate a considerable moral effect from the silence of the pauses, and probably with reason. We may remember Marshal Bugeaud's account of the effect produced on the French soldiers by the silence and steadiness of the English line when their columns advanced to the assault, shouting as they got near "*Vive l'Empereur*," with some confusion, and some firing.

"The English line," he wrote, "remained still, silent, and immovable, with ordered arms, even when we were only 300 paces distant, and it appeared to ignore the storm about to break.' The contrast was striking; in our inmost thoughts, each felt that the enemy was a long time in firing, and that this fire reserved for so long would be very unpleasant when it did come. Our ardour cooled. The moral power of steadiness which nothing shakes over disorder which stupefies itself with noise, overcame our minds."

This frank and generous testimony from a gallant foe has often been quoted, and may serve to remind us, without undue elation, of the high discipline our soldiers can attain to. We may at the same time observe that such forcible expressions as "the moral power of steadiness" and "disorder which stupefies itself with noise" may in these days be made applicable to the steady force produced by fire-discipline as contrasted with the disorder of wild unregulated fire.

[1] "Infantry Fire Tactics," by Lieutenant Mayne, R.E.
[2] "Infantry Fire Tactics."

Our course of musketry instruction requires remodelling to bring it into harmony with the tactical requirements of the day. Great labour has been bestowed on these regulations, which prescribe in minute detail the course to be followed; but they make no allowance for individuality, and are based on the theory that every "man who has no defect in his sight can be made a fairly good shot"—and that individual fire is all-powerful in the field.

The following extract from the "Militär Wochenblatt" for January, 1885, gives a German view of our system of musketry instruction (1884).

The writer objects to the routine of work so strictly laid down, thereby allowing no scope for individual instruction; considers that the able recruit is kept back by the slow one, and that the latter can get no proper care or attention. In Germany the recruit's education is built on a sure foundation, whereas in England they seek to make him a rifleman in eighteen days. On the sixth practice day the English recruit shoots at 500 yards. In Germany only a second class shot, one therefore at least in his second year of service, would shoot at that range. In Germany the most important part of the instruction is considered to be the practice at short ranges, whereas in England every effort is directed to get the rifleman to shoot at long ranges as quickly as possible. In his first year the German recruit only fires at 100, 150, and 200 metres, being allowed for each distance 20 rounds. The qualification for shooting at the longer ranges is lower in England, or only 75 points are required to pass into the second class, which might be obtained by 3 bulls-eyes, 5 centres, and 24 outers, that would be 38 misses out of 70 shots. Yet the writer admits that our musketry regulations of 1884 show a considerable advance on those of 1879. The Company Officers are now entrusted with the duties of instructing the men, more rounds are allowed and more attention given to field practice.[1] The value of thorough careful instruction at short ranges is, however, not yet recognized, but every endeavour is made to push on a recruit so that he may fire at long range. This is contrary to the German deductions from the war of 1870–71, the conclusion given in the General Staff Report being that the decisive fire is at short ranges, and that only thorough instruction at such distances can give that sureness of aim necessary to repel a frontal attack in the open field.

I shall not presume to enter on the large question of musketry instruction, which is, I understand, in course of being rewritten, and which would be far beyond the limits of this paper, yet as all infantry fire tactics must be based upon it, I will venture briefly to summarize what I think we want in order to bring the course of musketry instruction into harmony with the requirements of war.

What we want is to have our men thoroughly well trained individually at close ranges. The most important training is field firing under conditions resembling a battle. Men should be taught firing by groups, and judging distance amid the noise and confusion

[1] We have, since the writing of this article, introduced the section on Musketry Fire Tactics in our Field Exercises of 1885.

of a fighting-line, but under rigid control and fire-discipline, taking advantage of cover as if under fire. Our soldiers should also be practised in rapid loading and quick aiming, as they should learn to hit not only with slow but also with quick firing.

We will assume that we have a sound system of musketry instruction and fire-discipline. It is now for us to consider on what general principles the attack of a position should be conducted. The late Colonel Home in his valuable work on Modern Tactics observes: "The attack on an enemy's position is based entirely on the science of the attack on a fortress," but I think the comparison a somewhat misleading one. A regular attack on a fortress with its successive places of arms is a bad model for the infantry attack, although it certainly offers a strong analogy to the conduct of the artillery fire.

Artillery fire tactics do not come within the scope of this paper, so important a subject requires a paper to itself. The conduct of artillery fire in an attack is, however, so intimately connected with the fire tactics of the infantry, that a brief allusion to it is necessary.

In the Franco-German War the artillery, especially on the German side, played a much bolder part than is usually assigned to it in peace manœuvres. Prince Hohenlohe writes: "The war of 1870–71 completely dispelled the old prejudice against allowing artillery to enter within the limits of rifle-fire." In a lecture at this Institution in May, 1883, Colonel Brackenbury stated that "all modern tacticians worthy of the name are of the same mind: they say that though artillery will suffer heavy losses by advancing into the front line in the later periods of the fight, yet the game is well worth the candle."[1] As we all know, there were plenty of instances even in the early battles against trained troops when the German artillery was pushed boldly to the front. At Spicheren the two Prussian batteries came into action on the Rotherberg within 800 paces of the French infantry in shelter-trenches, and although they lost half their gunners their advance enabled the infantry to keep their ground. Borny, Vionville, and St. Privat furnish abundant instances of artillery being boldly yet judiciously handled, and although suffering heavily, giving effective support to their own infantry. The well-known case of the advance of the four batteries of the 7th Army Corps at Gravelotte is an instance of injudicious boldness, but the rule that obtained in the conduct of the artillery was that it should enable the infantry to hold the ground they had gained and expose itself to any loss rather than let the infantry be driven back.

I assume then that our artillery will adopt the same bold tactics in the attack of a position, and advance so as to take up successive positions from whence to silence the enemy's artillery and co-operate with the advancing infantry. Strong detachments of infantry taken from the reserve should always be provided to protect the batteries, who should be furnished with entrenching tools, so as to be able to throw up cover for themselves and the guns. The infantry accompanying the guns might also employ with advantage rifle-fire at long range against the position or against any suitable objective either by

[1] "Journal," No. CXX, p. 439, *et seq.*

mass or volley firing. The objections so strongly urged against the use of long-range fire by the infantry of the attack would not apply to them. They are briefly stated—

1. Excessive expenditure of ammunition, leaving insufficient for decisive fire at short ranges.

2. Loss of attacking power, or offensive spirit, the danger of drifting into a fruitless fire at long range without advance.

3. Difficulty of obtaining or correcting range.

No. 1 is the most important argument against long-range fire, and is decisive against infantry advancing to attack a position. If, however, each battery were accompanied by an infantry ammunition cart (carrying 9,600 rounds) there would be abundant supply for the detachment of infantry, in addition to what the men would carry, so that there would be no fear of their running short of ammunition. No. 2 would not apply, as the infantry would move forward with the artillery, and as regards No. 3, the artillery have superior means for determining the range, which the infantry with them would profit by.

German authorities do not recognize long-range rifle-fire for the attacking force, but unless other objections can be produced than those above, it seems unwise to deprive the attack of so powerful an ally. If, as they say, it is a great disadvantage to the attacking force to open musketry fire at a greater range than 600 yards, then the Russian Krinka rifles in the war of 1877–78 should have given it an advantage, as they were only sighted to that range. In a very interesting lecture in June, 1878, in this Institution, on "Lessons from the Late War," it is stated that owing to their terrible losses from the long-range fire of the Turks, "rough wooden sights were manufactured in some (Russian) regiments and adjusted to the rifles, but as this expedient naturally could not increase the actual carrying power of the weapon it advantaged the Russians but little, and they could not reply with effect to the fire that was devastating their ranks."[1]

The proposal to co-operate with the artillery by long-range rifle-fire is not a new one. General Hardinge, in a lecture delivered here in March, 1879, proposed having distinct duties for the infantry of the attack, some to prepare the advance, some to cover its nearer approach, some to reach the ultimate goal.[2] Similar views have been more recently advocated by Lieutenant Mayne, R.E., and others. There is, however, strong authority against such employment of infantry. Our own regulations say: "The preparation of the attack at long distances belongs to the artillery, it is only in exceptional cases that the infantry can take part in it." The German regulations say that "the preparation for the attack is indispensable, and it would certainly be best to leave it entirely to the artillery so as to avoid a long weary rifle fight." Prince Hohenlohe is strongly against allowing infantry to fire up to 1,000 or 1,100 metres when artillery is available, and gives an account of a competition between a company of infantry and a battery, *at unknown ranges*, in which the

[1] "Journal," No. XCVIII, p. 941, *et seq.*
[2] "Journal," No. C, p. 402, *et seq.*

result was greatly in favour of the artillery. But the proposal before us is not to compete but to co-operate with artillery, and so get the benefit of the range-finding power of the latter. When you take into consideration, writes Prince Hohenlohe, "the excitement of battle, the comparison will be still more to the disadvantage of infantry, for when the soldier's blood is heated the weapon will shake in his hands, whereas the cannon has no nerves." Prince Hohenlohe has, however, to admit that *gunners* have nerves, and referring later to some bad artillery practice under fire states: "I had to take strong measures to get the gunners to resume a steady and orderly fire" (No. CXXX "Royal United Service Institution Journal"). I do not believe that good infantry, especially when firing from behind shelter-trenches as here proposed, would be in a state of wild excitement, and I should anticipate some good results from controlled volley or mass fire under such conditions even at long ranges when the distance has been determined by artillery.

Our own regulations prescribe placing troops from the reserve in commanding positions on the flanks who are to cover the general advance by volleys. Where such positions exist this would of course greatly strengthen the attack.

Some of the guns must be held in readiness to push on to the positions as soon as taken accompanied by the infantry escort with entrenching tools and ammunition cart. The well-known instance of Skobeleff's infantry on the Green Hill at Plevna using dishes and bayonets to get cover shows the necessity of having entrenching tools ready for a lodgment.

The action of the artillery in the attack on a position would therefore be very similar to that of the siege batteries in the attack on a fortress. Concentration of fire, first on the enemy's artillery and then on his infantry, can be most effectively obtained by massing the guns. This method has, however, the objection of offering a large target, and in the attack of a position it may often be found advantageous to follow again the analogy offered by a siege and get a concentrated fire from dispersed batteries with the aid of signals or field telegraph, but all such arrangements would of course depend on the nature and lie of the ground.

So far we have only been considering the fire required to prepare the way for the infantry of the attack. As regards the much-debated question whether the attacking infantry should ever be allowed to open fire at long distances, I think all the experience gained since 1870 goes to show that long-range rifle-fire is favourable to the defence but fatal to the attack if used by the troops designed for the assault. The regulation in the German Service is that every effort should be made to prevent the attacking troops opening a serious fire before they enter the effective zone, 400—500 yards.

Our regulations say that "a premature opening of fire by the fighting-line may lengthen the action and lead to a deficiency of ammunition at the final stage, and thus weaken the moral energy of the assailants." And in the next paragraph, troops are only autho-

rized to begin firing at "medium" distances in open ground, that is, within 700—900 yards of the enemy.

The danger of opening fire prematurely is strenuously enforced in all Continental regulations, and even the Russians, who suffered so fearfully from long-range fire, lay down in their latest regulations that as only close fire is decisive, the long-range power of the rifle must be used with extreme reserve, and then only when the result is pretty sure to justify the expenditure of ammunition.

But the question of long-range infantry fire, as indeed of all infantry fire tactics, is intimately connected with the supply of ammunition in the field, a subject to which too much attention cannot be devoted in peace-time.

The question whether musketry fire is effective at long ranges is only of secondary importance. The important point is, will there be cartridges enough for fire at both long and short ranges? If not, the former must give way to the latter, as we all know that battles can only be decided at close quarters. In defence of a position, where men have their reserve supplies close at hand—like the Turks at Plevna—long-range musketry fire would be most valuable, especially against large targets, such as a mass of guns, cavalry, or infantry columns. Against troops advancing to the attack long-range rifle-fire would always be of great value, especially if the artillery of the defenders has been partially silenced. Independent of its physical effect it would create a strong desire in the attacking force to reply by long-range rifle-fire, thereby delaying its advance and weakening its power for the decisive fire-combat at the shorter ranges. The defenders would also generally have the advantage of firing at known ranges. But for the attack the question of long-range rifle-fire is mainly if not entirely one of supply of ammunition.

"The timely supply of ammunition to troops in action is one of the most difficult services in war. Of what use is the most scientific strategy on the part of the General, or the most heroic conduct on the part of the troops if, at the most critical moment, the latter are exposed without defence to the attack of the enemy?" [1]

In our Service each man carries 70 rounds into action, 40 in his pouches and 30 in his valise. This quantity may be increased on an emergency, as at Tel-el-Kebir and in the late Suakin expeditions, when the troops went into action with 100 rounds on their persons. There is, however, some difficulty in getting at these extra cartridges, owing to want of pockets or pouches for carrying them.

"The German arrangement consists of two small tin boxes, placed on each side of the knapsack, and covered with a flap. These two boxes hold all the cartridges which the man's pouch will not take. If a man wishes quickly to refill his pouch, or in case of his being wounded or killed, one of his comrades has but to raise the flap and the box of ammunition is easily got at." [2]

The Russian soldier now carries 84 rounds, but in 1877 he only carried 60, and General Liddeler strongly recommends that he should

[1] Prince Hohenlohe.

[2] "Supply of Ammunition to Infantry." Translated by Captain Waller, R.E. No. CXVI, "Journal."

carry 105 rounds, with a corresponding diminution in his general equipment.

In a discussion on a lecture here in June, 1878, Captain Trotter, R.E., stated that in the Turkish Army under Mukhtar Pasha in Asia Minor, "the men were provided each with 150 rounds of ammunition; they carried 50 rounds in their pouches, and the other 100 rounds, some, like the Circassians, in pockets made on the breasts of their tunics, and others in their havresacks . . . or in any other place where they could find room."[1]

Our battalion reserve ammunition consists of three carts carrying 30 rounds per man for a battalion 960 strong. It has been suggested to increase the reserve by an additional cart, so as to bring it up to 40 rounds per man (see "Infantry Fire Tactics").

I should much prefer to see a few mules attached to each battalion for this purpose. Eight mules would carry as much as a cart, and could follow the infantry where a cart could not.

Assuming a battalion to have only 800 men in the ranks, then 3 carts and 12 mules would carry 72 boxes of ammunition, or 54 rounds a man. Suppose the battalion had to advance for attack over ground where the carts could not follow, then by issuing 30 rounds per man to the fighting-line and supports (400 men), 20 boxes would be emptied and 15 rounds to the main body would empty 10 boxes more, leaving 42, which for a short distance could all be carried by the 12 mules. With a carefully prepared equipment, mule transport would be quickly organized on the outbreak of war, but it is most desirable that there should be a detachment of ammunition carriers to each battalion, who should practise in peace-time all the duties connected with the supply of ammunition in the field.[2]

Some of Prince Hohenlohe's observations on this subject are worth quoting:—

". . . . You cannot, under any circumstances, safely reckon upon providing them (the infantry) with a fresh supply when attacking across the open from the time they get within 500 metres of the enemy to the moment of closing with him. All suggestions which have been made with this object must be considered inapplicable to this stage of battle, however practicable at long range during intervals of inaction, or when on the defensive."[3]

With this and similar evidence before us we cannot resist coming to the conclusion that as a plentiful supply of cartridges at short ranges is vital to the success of the attack, and as at that period of the fight it is impossible to supplement the supply, the attacking infantry cannot afford to spend ammunition at long ranges. To this may be added the other important reasons for reserving fire as much as possible, which have been already referred to, viz., the delay in advance, and the weakening of the energy of the men. With a good system of fire-discipline fire should not be opened before reaching within 600 yards of the enemy's position, assuming some cover to be

[1] See "Journal," No. XCVIII.

[2] The regulation first supply for the fighting-line is at present less in our Service than in Continental Armies. The introduction of the solid-drawn cartridge will enable the ammunition to be carried in bags without fear of injury.

[3] No. CXXX, "Journal Royal United Service Institution."

available, and up to 400 yards the fire should be under control. Group or section volley firing will be capable of being maintained at closer distances than any other form of controlled fire, so long as the groups can be kept together. This, therefore, is the form of firing on which most stress should be laid in field practice in peace-time.

Infantry fire tactics is too large a subject to be fully dealt with in a short paper, and I have only been able to touch on the main points.

Our next subject, "Attack Formations," is one concerning which it is less easy to get precise guidance, so much depends on the character of the troops concerned and the power of the arms employed; a progressive quantity.

Some sound guiding principles are undoubtedly required, which can be obtained mainly from the experiences of the war of 1870–71. Nothing can be more instructive than the changes in German tactics, brought about by their terrible losses in the early battles of this war. Nothing should more strongly impress writers on tactics with humility and a distrust of the perfection of their own prescribed formations than the fact that the German leaders, with all the foresight and the knowledge acquired during twenty years of careful training with a breech-loading rifle, including two wars, should yet have been ignorant of the breech-loader's actual power in the field, and consequently of the tactics required to oppose to it. At the outbreak of the war the Germans were hampered by their drill regulations, in which the skirmishing line played a subordinate part to close column.

"In field day exercises," wrote Captain Layman, "critics always laid the greatest emphasis upon the numbers which could be brought up *closed* for the decision; the fighting efficacy of the skirmishers was not rightly valued."[1]

Under the searching fire of the Chassepôt, columns were rapidly deployed and hurried to the front, and

"without allowing sufficient time for the artillery to take effect, masses of infantry threw themselves into the fight. . . . From the rapidity with which an attack is executed at peace exercises, the leaders are not conversant with the idea that the enemy can only be shaken by a protracted fire fight on their side, gradually brought nearer by a careful use of the ground. The leaders who were fighting in front in the first line very soon urgently demanded support. They were accustomed to consider only those troops fit for fighting who at any rate retained some kind of order, and still preserved a solid nucleus. Now they very soon saw their whole force raffled together in a confused swarm of skirmishers totally extended, and apparently mocking all order and guidance. Thus, by degrees, we see whole divisions extended in a skirmishing line."[2]

If such unforeseen changes in tactics could be so rapidly produced in an army organized with so much foresight and after so much experience by what must be called undisciplined, unaimed, long-range rifle-fire, who can say what further modifications may have to be made against disciplined fire of far higher intensity, such as may be expected from magazine-rifles and machine-guns at effective range?

[1] "The Frontal Attack of Infantry," translated by Major-General Newdigate.
[2] "Frontal Attack."

German tactics have been in a state of healthy growth and progress since the war, and the authorities are careful to give no typical attack formation in their Drill Book, so as not to indicate finality, or to relieve the Commanding Officer from the necessity of exercising his own intelligence as to the formation required on any given occasion.

Von Boguslawki, in his last work on "The Development of Tactics since the War of 1870–71," after summing up the course of a frontal attack on a plain, admits that the existing system of attack is far from giving satisfactory results.

"The duration of the fire combat, the enormous losses, the pushing forward of fresh bodies of troops, cause a disintegration and confusion which increase the difficulty of command to the utmost, withdraw the men from the superintendence of the leaders, and make it easier for those of weak moral and physical nature to shirk the danger of the fight. This must be considered the weak point of the existing tactics."[1]

This weak point is what we must work at in peace-time. We have now to consider how to adapt our tactical formations so as to retard and minimize this inevitable disintegration and confusion.

"In an army, the less there is of harmony between its regulation tactics and the tactical requirements of the age, the greater will be the confusion attending its infantry attack."[2]

The leading principle I would propose we should consider as essential to every attack formation, is that of "tactical cohesion." This requires that when the fighting-line is reinforced by the supports, each company should be under the control of its Captain, and that the Commander of the main body should have a wing or double company under him and not merely a certain proportion of men. With this principle in view, I would advocate the half-battalion being organized as a distinct fighting unit.

Some writers recommend a second line or wave of skirmishers to reinforce the first. Probably the supporting force would lose fewer men in this formation, but it would entirely lose the character of a support in the sense of being a physical and moral prop to the fighting-line. Other writers have even recommended that the main body should advance in successive extended lines.

"Such a formation," wrote Home in 1873, "tends not to prevent but rather to produce and perpetuate what is the great danger of this kind of fighting, viz., a gradual cessation of all the elements of regular order, and a gradual dissolution of the whole force into the skirmishing line . . . that formation" (for the supports and main body) "should be adopted, which will enable the leaders to hold the men most thoroughly in hand, keep them completely under their eye, and at the same time advance as rapidly and with as little confusion as possible."

If extended in successive lines, the supports and reserves would not be available for protecting the flanks, as they could only move direct to their front or rear. And yet, with all these palpable defects, this formation is not lightly to be rejected, as it is the one in which Skobeleff made his successful assaults at Plevna, and was, he considered, the only possible one.

[1] "The Development of Tactics," by Colonel V. Boguslawski.
[2] "The Soldier's Pocket-Book," by Lord Wolseley.

gress
ttack
elieve
own

actics
ontal
s far

ard of
se the
dence
ure to
of the

have
etard

ation
ll be

ssen-
This
orts,
that
com-
With
eing

rs to
ewer
of a
the
main

er to
viz., a
on of
sup-
hold
nd at

ould
nove
ects,
hich
con-

ILLUSTRATION OF A FLANK ATTACK.

Fig. 3.

TWO

Fig. 4.

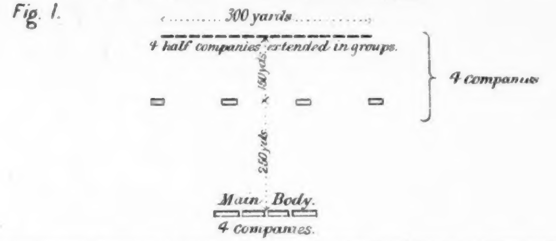
Harrison & Sons.

ONE BATTALION IN NORMAL ATTACK FORMATION, HALTED.

2ND STAGE

(AT 1,200 TO 600 YARDS FROM ENEMY'S POSITION).

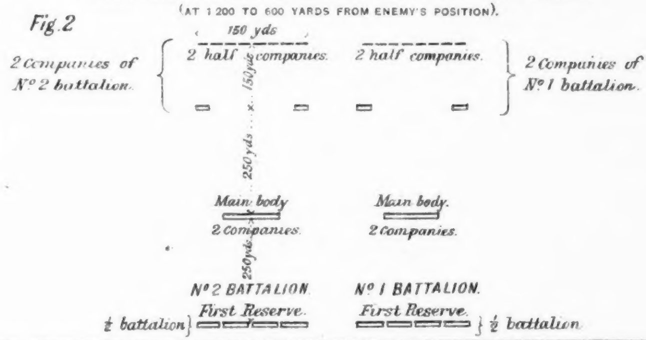
Fig. 1.



TWO BATTALIONS HALTED IN ATTACK FORMATION FOR FRONTAL ATTACK. 4 MEN TO THE PACE.

(AT 1 200 TO 600 YARDS FROM ENEMY'S POSITION).

Fig. 2

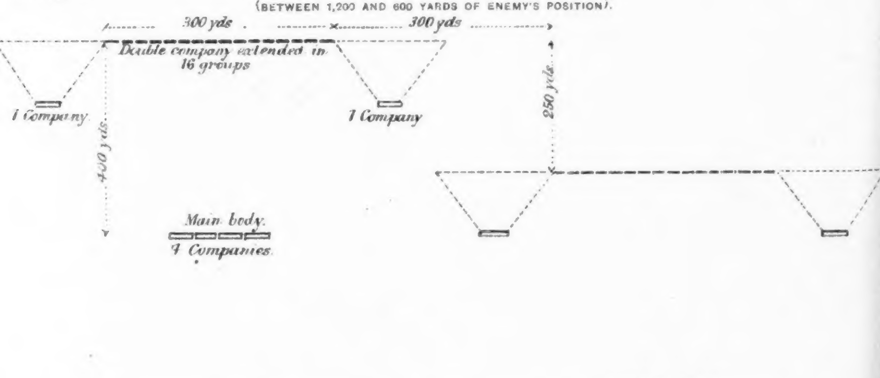


TWO BATTALIONS HALTED IN ECHELON ATTACK FORMATION WITH SUPPORTS ON FLANKS.

Fig. 4.

2ND STAGE

(BETWEEN 1,200 AND 600 YARDS OF ENEMY'S POSITION).



Harrison & Sons, Lith. St Martins Lane, W.C.

sy
on
th
an
be
th
ta
be

be
th
as
to
co
an
wo
"a
fig
su

"
spe
tio
eve
cer
not
a b
rai
col
do

lie
res
zor
en
pap
cou
an
tic

"
Off
be
att
con
and

no
for
pr

The four-deep formation, which is another variety of the wave system, has been very forcibly and ably advocated in this Institution on several occasions by Colonel Macdonald, but as it appears to me that formation involves dissolving all tactical cohesion at starting, and trusting to its being restored by every man coming into his place before the final rush. The principle of tactical cohesion demands that the fighting-line, supports, and main body should consist of tactical sub-units, so that, if required, the supports or main body may be diverted to a flank without producing confusion.

The supports and main body must move in such formation as is best suited to the ground, while enabling the commanders to keep them in hand. Close formation should therefore be retained as long as possible, and, as a general rule, all halts should be in line. Up to 1,200 yards from enemy's position the enemy's musketry may be considered as unaimed fire, so that up to that distance the supports and fighting-line may be kept near together. The advantage of this would be greater tactical cohesion up to the entrance into the zone of "aimed fire," and consequently a feeling of greater confidence in the fighting-line, especially when one or two sections of each company in support is extended in the fighting-line, as will usually be the case.

"It is important to observe that in passing through the 'unaimed shot sphere,' speed alone can diminish the risk of loss. Avoid it, or cross the least intense portion of it, if that be possible, but formation can affect the question in no way whatever, except as it may affect the speed. Bullets are flying at a given rate within certain limits, and if all must pass through those limits the individual chances are not affected by being in company. It would be otherwise reasonable to assert that a body of men marching in skirmishing order would be reached by fewer drops of rain, *i.e.*, would get less wet, than if they passed through at the same pace in column, or that you would get less wet walking alone in the rain than you would do in company with a friend."[1]

At about 1,200 yards from the enemy's position the infantry will lie down, the supports and main body previously forming line, and rest while the guns are brought up to prepare their road through the zone of aimed rifle-fire. Beyond this distance (1,200 yards from the enemy's position) it is worse than useless to attempt to lay down on paper drill diagrams showing the various stages of the fight. These could only represent parade manœuvres misleading to both Officers and men, as the extended order exercises should always, when practicable, be performed on broken ground.

"On every instruction parade where there is variety of ground, the Commanding Officer should explain to the Officers the supposition under which the practice is to be carried out, the object to be attained, and the manner in which he proposes to attain it; also the nature of the ground and how it is to be utilized. The Officers commanding companies will repeat this briefly to their non-commissioned officers and men, explaining to them the part they will have to take in the manœuvre."[2]

Nothing can be more sound and practical, and it is probably better not to fetter the instructions with formal diagrams. A few typical formations are no doubt useful in illustrating principles to be adopted, provided the diagrams are not taken as instructions. With this idea

[1] Colonel Gawler, "Modern Tactics."
[2] "Field Exercises," p. 212.

I venture to submit three types of suggested formations in what for convenience we may call the second stage of the attack, 1,200—600 yards from the enemy's position. The formation must of course be based on an estimate of the resistance expected and probable force required at the final stage to overcome it, irrespective of reserves, which must be kept ready for emergencies. Assuming a large development of front so that a concentrated fire could be brought to bear upon the enemy's position, then a formation of two men to the pace, such as shown in Fig. 1, Plate IX, might be suitable. If a direct frontal attack be intended, then the formation in Fig. 2, is proposed, giving four men to the pace, followed by two lines of attack in reserve, the half-battalions working as separate tactical units. But of course a frontal attack ought never to be made, as it never would succeed against good troops unless combined with a flank attack. In the German Drill Book (p. 149) it is laid down as a fact to be strongly impressed on their infantry, that their front is unassailable when their flanks are secure, that in such a position they are invincible. "The enemy's bayonets are nothing to them, and even supposing him to have an equally good rifle it will be at a most decided disadvantage, since his movements will not permit of his taking cool and steady aim." Yet front attacks must continue to be practised, as a flank attack may often be tactically a front one.

As stated by Colonel Clery, "the system of breaking down the enemy's resistence by penetration has given way to that of envelopment." The plan of working round positions while tying the enemy down in front was well illustrated by General Gourko in forcing the passes of the Balkans. Fig. 3 is an ideal illustration of a flank attack with a force of equal strength to that of the defenders, taken from the late Colonel Home's work on tactics,[1] of which the following description is given:—"An army, A.B., on the defensive has one wing strongly posted at A. It is induced to spread the other out towards B by a demonstration in its front. The attacking army occupying the wood in its front strongly, place a portion in a state of defence so as to check any advance of the enemy to the front, and seeing that the nature of the ground at A is such that a counter-movement in that direction cannot be easily made, moves round to that flank, preserving the line of communication towards D, and by concentrating a fire on A the attackers are enabled to carry that point."

The containing power of the breech-loading rifle behind slight entrenchments is so great that in future wars we may expect to see battles decided by flank attacks, the side that takes the offensive making a previous demonstration against the front, and strengthening his positions by entrenchments, so as to have all available force at the decisive point. It is, therefore, very desirable that a certain proportion of entrenching tools should be carried by the troops with a reserve supply in wagons.

Fig. 4 is suggested as a type of an attack formation, which may

[1] I have taken the liberty of altering Colonel Home's formation of the supports, which in his sketch are shown in columns of two companies.

be in échelon, either to gain an enemy's flank or in anticipation of a flank attack. This is a formation on the double-company system, the supports reinforcing to the flanks of the fighting-line. In the German drill regulations (page 143) this method of reinforcing by prolonging the fighting-line is recommended as much more effective than by pushing in between groups. In either case some lateral movement is required from the men in front, and although it is asserted that men will only move straight to their front or rear, yet there are examples to the contrary in the war of 1870-71. At the attack on Le Bourget near Paris it is stated that "the mechanism of the attack consisted principally in the rapid change from open to close order directly the most trifling cover admitted of the rallying of a subdivision or company. On the other hand, every advance over open ground took place in widely-extended skirmishing lines, which moved on like ants."[1]

The formation of Fig. 4 involves the necessity of the men in the fighting-line closing in on their centre as losses occur. This is in accordance with our last regulations, and I cannot agree with those who consider it impracticable. This formation would have the advantage, besides that of maintaining the larger tactical units, of not exposing the supports to the fire which would pass over the fighting-line. The supports could also protect the flanks of the fighting-line by volleys when required. In reinforcing the fighting-line the supports would have a definite point to extend from, viz., the flank of the firing-line in their front.

As regards the probable loss reinforcements will suffer in coming up to the fighting-line, a theory has sprung up (based apparently on an incident of the battle of St. Quentin in January, 1871) that the rifle-fire and artillery of the attack will so engross the attention of the defenders that they will allow the reinforcement to approach almost in close formation without much loss.

The well-known German writer, Von Scherff, observes on this point,—

> "The artillery, and in a short time the infantry, of the defenders becomes the object of the attackers' fire. It follows that their fire will be directed from that portion of the attacking force which composes the main body (or the true assaulting party). The more the troops charged with the preparation of the attack succeed in drawing on themselves the defenders' fire the better they will do their work. A defence properly conducted will seek not to be so led, but it cannot help itself, though it may, perhaps, avoid directing all its fire on the fighting-line, and may direct a portion on the supports and batteries. If, on the one hand, the fire of the defenders does not check the advance or fighting-line of the attackers, it will be destroyed by their fire, united to that of the attacking artillery. If, on the other hand, the defenders concentrate their fire on the fighting-line they indirectly facilitate the advance of the main body of the attackers. And this is the dilemma on which the possibility of the attack mainly rests, and hence the necessity of giving the troops engaged in preparing the way, a considerable force."

This writer is considered by some as too much of a theorist, and certainly would have found his logic confronted by hard facts had he been present at the fourth counter-attack of the third battle of

[1] Duke of Wurtemberg.

Plevna, which was repulsed by General Skobeleff being illogical enough to fire "not on the Turkish firing-line but on their reserves in rear, whom he thus compelled to withdraw, and who were soon followed by their firing-line."[1]

It is not wise to build up a theory of attack on the expected blunders of your enemy, and it is very remarkable that the author of the "Frontal Attack of Infantry" should, at p. 27 (of Major-General Newdigate's translation) have penned this sentence: "When the skirmishers are once involved in a fire action with the enemy, closed detachments can come forward with insignificant losses." This very important inference he bases entirely on the following incident: "On the 19th of January, at St. Quentin, two companies of the 8th Rhenish Infantry Regiment, No. 70 upon the right wing of the 16th Division, were brought forward to protect the batteries of the Division from the enemy's infantry fire. One zug of each company was sent out to skirmish with two closed züge following in support at 100 paces; these suffered very severe losses at a distance of 800 paces whilst passing over a hill—one-sixth of the effective state in a few minutes. On the other hand, the two remaining companies of the battalion which were brought over the same height an hour later hardly suffered at all, although no change had taken place in the French position. The attention of the French was now completely rivetted upon the fire action at a distance of about 400 paces." This is certainly a noteworthy incident, but one that could not be *always* expected to happen. Curiously enough the same author, at p. 17, especially warns us "against drawing too rapid and optimistic conclusions from the actions in the second period against the troops of the Republic." This most just observation is apropos to a previous remark upon the quality of the troops opposed to them, and an illustration is taken from the same battle of St. Quentin to show that "against such an enemy even closed attacks could be made without losses worthy of mention."

The lesson for us to draw from these incidents is the all-importance of fire-discipline in defence as well as in attack. When the Germans still had trained troops opposed to them they found it less easy to advance or bring up reinforcements during action. In a lecture by Colonel Hale, in June, 1876, a most graphic description is given of the erratic advance of the 3rd Battalion of the 35th Regiment at the battle of Vionville. The 2nd Battalion endeavoured to gain from the cemetery hill the clumps of trees lying between Flavigny and the high road. "The two foremost companies only succeeded in gaining any ground in this direction, whilst the half-battalion which followed was so reduced by the enemy's fire in crossing the heights that the *débris* had to be rallied at the cemetery."[2]

In reinforcing direct to the front, the control of the fighting-line depends in great measure on the cohesion of the groups, who should push in on the flanks of the groups in the fighting-line, the latter closing inwards as their numbers diminish.

[1] Note, p. 218, "Infantry Fire Tactics."
[2] German Staff account.

As regards the strength of the fighting-line it is evident that once the rifle-fire has commenced in earnest, say, when within 600 yards, or in perfectly open country, 800 yards, the attacking infantry must be reinforced so as to get a superiority of fire. Beyond 1,200 yards it would be better to have only a weak line of skirmishers, as there would then be less chance of expending ammunition.

For convenience of reference it is necessary to divide the attack into different periods or stages, but it should be clearly understood that this is by no means an arbitrary division, but must of course be regulated by local circumstances. I would propose the following divisions:—

1st stage.—Up to 1,200 yards from enemy's position supports to be close up; one section only extended. Second position for artillery at 1,200 yards with infantry. Latter to fire volleys at this distance in conjunction with artillery.

2nd stage.—1,200—600 yards. Supports 150—200 yards in rear of fighting-line near flanks. Main body 400—500 yards in rear. General rifle-fire opens at 600 yards.

3rd stage.—600—300 yards. Fighting-line gradually reinforced during this stage. Main body brought up within 200—300 yards of fighting-line.

4th stage.—300—150 yards. Advance by alternate rushes. Fighting-line reinforced by main body, and formed for assault at 150 yards.

Something remains to be said on the subject of advancing by rushes, which I have assumed to commence at 300 yards, although it is usual in drill exercise to begin rushes earlier. Like the general opening of fire, "rushing" should be deferred as long as possible, that is, until the men cannot advance by any other method. In our "Field Exercises," p. 227, it is stated in a footnote that "a rush is permissive—not obligatory." The diagram on Plate XXVIII, however, shows the fighting-line advancing by alternate rushes at 500—600 paces from enemy's position.

In the campaign of 1870–71, the German troops suffered heavily from the French long-range fire, but when within about 500—600 paces frequently found the French fire pass over their heads, and that by pushing rapidly forward they escaped loss, and completed the demoralization of the enemy. It was the same with the Russians against the Turks at Plevna. It is hardly safe to infer from this that rapid movements or rushes commencing at 600 yards will be successful against an enemy trained in fire-discipline. If it be true that the rapidity of the attackers' advance will reduce the effect of the defenders' fire, it is no less true that the same cause will also greatly reduce the effect of the attackers' fire. Now this, again, must react upon the defenders, for suppose as an extreme case that the result of the breathless state of handshaking unsteadiness produced by the great exertion of rapid movement should so affect the firing of the attackers as to make it as harmless as blank cartridge practice, the defenders being no longer under effective fire would be proportionately cool and collected, so that their fire would become more concentrated and deadly.

General Hardinge, in a lecture already referred to ("Journal Royal United Service Institution," vol. xxiii), stated—

"That from the results of field-firing carried out in India, it was found that the best effect for the Martini-Henry rifle was obtained between the ranges 900 and 600 yards, because the shorter ranges are only reached by rapid advances, and *this gain of distance is more than counterbalanced by the loss of breath and other physical disabilities which impair the accuracy of the weapon.* Breathless haste may avoid losses, but steady fire can alone inflict it. Speed of movement and steadiness of aim do not go together."

Prince Hohenlohe writes on this subject like a practical soldier:—

"Skirmishers must be made thoroughly to understand that it is only allowable to run in moments of extreme urgency, as running heats the blood and makes the hand unsteady. I am not making any undue demand upon skirmishers when I require them to move steadily and calmly forward under fire, always of course supposing its effects not to be too deadly."[1]

The German regulations permit of the advance by rushes when necessary, adding the following caution:—

"The progress of the attack will, however, be retarded by such method of advance, by which much strength is expended, and it must not therefore be commenced at a greater distance than 500 paces from the enemy . . . The general direction that all movements of the fighting-line should be in quick step without doubling may only be departed from in exceptional cases."[2]

A good suggestion was made by Captain May, in his well-known "Tactical Retrospect of the War of 1866," as regards the necessity for watching over troops during the advance, and especially when it comes to alternate rushes. It is that each company should have an Officer in the supernumerary rank who should be made responsible for the men moving up together.

This paper commenced with a few observations in reply to some criticisms that have appeared respecting the use of square formations against savages in thick bush, whose principal arms were spears, and whose tactics consisted in desperate charges, with hand-to-hand fighting. I wish now, before concluding this paper, to be allowed to make a few remarks on the use of squares from extended order in the presence of an enemy armed with long-range artillery and all the latest engines of destruction. In our Drill Book (pp. 235 and 101), authority is given for the extended line if attacked by cavalry to form groups, when the right and left files of every four will close to each other, and act as required. No objection can be made to this direction, when taken in combination with the previous instruction that infantry if kept well in hand have nothing to fear from cavalry. In the following paragraph, however (p. 101), permission is given to form rallying squares, although Officers are reminded that by doing so "they lose at a most critical moment their power of offence, and become an easier mark for artillery fire." It is a grave question whether such a formation ought to be recognized in our drill as applicable under *any* circumstances to troops in extended order, and under effective fire of artillery. Otherwise it is to be feared that

[1] Translated by Sir L. Graham, "Royal United Service Institution Journal," vol. cxxx.
[2] "German Drill Regulations," p. 141.

Officers and men will be drilled to form rallying squares on the appearance of cavalry when in extended order, and will accordingly adopt it in the field, or should the Commanding Officer, with truer military instinct, decline to have his men massed into a large target to be mown down in heaps by shrapnel, he assumes a great responsibility, and his men, from their previous teaching, will not feel the same confidence in the group formation as in the square of the drill-ground. It takes also some time to form a rallying square from extended order, and if this formation be intended the order would have to be given on the first appearance of the enemy's cavalry, who might merely make a feint, wheel off, and leave the field free to their artillery to play on the devoted squares. It is not too much to say that an attack conducted on this system against an active enemy would be foredoomed to failure.

The Germans retain the battalion square in their Drill Book, possibly with an eye to its use in their future colonies, but German writers state that it is practically defunct. In our drill instructions for men in extended order, we say that a single man on broken ground has altogether the advantage on his side, but in the German regulations it is stated that also in a plain he has the advantage, and that he need not fear several horsemen, provided he remains calm and collected.

In the war of 1866, there were many instances of cavalry being repulsed with loss by infantry in line or extended order. After Gitschin, where the Prussian Bodyguard, while deployed in line, repulsed the vigorous charges of the Austrian cavalry, an order was issued to give up forming squares, and the only instance of a German square formation during the War of 1870–71 was that of the band of the 5th Jäger Corps at Sedan. At both Wörth and Sedan, cavalry were repulsed by infantry in extended order. To do this, infantry must, however, be well trained in peace-time, so as to have perfect confidence in their arms.

I will venture to quote one more instance of infantry receiving cavalry in extended order before concluding.

In a note by Colonel Sir Lumley Graham in his translation of Prince Hohenlohe, already referred to, there is an interesting notice of an encounter between cavalry and infantry near Mouzon-on-the-Meuse, on 30th August, 1870. A Prussian battalion having one company extended, its right "zug" being thrown forward, the latter was charged in rear by a regiment of Cuirassiers.

"The Captain of the company made this 'zug' face about towards the horsemen, and ordered the whole company on no account to close, but to receive the Cuirassiers as they stood, and only to fire when ordered. The Frenchmen charged home, but being received with a rapid independent fire, at close quarters, were repulsed with fearful loss, their Colonel, 10 other Officers, and 100 men being killed or wounded. The Prussian company did not lose a man, a few being slightly bruised by coming into collision with the horses."

This is an excellent example of what good infantry, well trained and well led, can do when charged in extended order by good cavalry, for the devoted valour of the French Cuirassiers on this occasion certainly entitled them to be called *good* cavalry.

Our infantry is second to none in the qualities of coolness and self-reliance, as proved in many fields, and with the requisite training could emulate or surpass the proudest feats of arms of any other troops.

The real value of this paper will, I anticipate, be in the discussion, and for the convenience of those who wish to take part in it, I will give a brief summary of the different points dealt with.

Training.—Individual training of men to be combined with group-system; thorough musketry instruction with good system of field-practice.

Fire Tactics.—Preparation by combination of long-range musketry fire with artillery. Attacking infantry to reserve fire up to 600 yards if possible.

Supply of Ammunition.—Amount carried by troops and in regimental reserve to be increased. Regimental organization of ammunition-carriers to be formed, and practised in peace-time.

Attack Formations.—Principle of tactical cohesion to be maintained as far as possible. Supports to keep near fighting-line up to 1,200 yards from enemy's position. Frontal attacks to be in formations by half-battalions, giving four men to a pace independently of reserves. Flank attacks to be employed. Echelon formation proposed, with flank reinforcement by supports. Advance to be made steadily, without rushes as far as possible.

Squares from Extended Order never to be formed. Cavalry attacks to be resisted in extended line by group formations.

The CHAIRMAN: My lords and gentlemen, I have now to invite a discussion upon the interesting lecture that we have heard. I am very glad that in the concluding portion of that lecture Sir Gerald Graham detailed very clearly the several points that he had referred to. I think, therefore, in the discussion it would be a great advantage if each gentleman who wishes to speak would confine his remarks to one or other of those topics, and not deal generally with all of them.

Major-General H. BRACKENBURY, C.B.: Lord Wolseley and gentlemen, I should like to say a few words first of all on the question of the squares of which General Graham has spoken. In matters of this sort I venture to think that an ounce of practice is worth a pound of theory. I have read in common with you all a great number of theoretical criticisms in newspapers and in magazines upon the employment of the square in fighting against the Arabs. I think the most powerful argument that it is possible to use in favour of the square formation is this, that General Graham, after having employed squares in 1884, and seeing them then at their best, and perhaps at their worst, employed them again in 1885, and that he has told us to-day that under similar circumstances, having to protect large masses of baggage and animals, he should employ them again. Further, when I was engaged under the late General Earle this time last year in organizing the force at Hamdab for the advance up the Nile, the tactical formation to be employed was very much engaging General Earle's attention. He then questioned the Officers of two Highland regiments who had been engaged under General Graham in the campaign of 1884, and I may say that without exception they all expressed the opinion that the square formation was the right formation to meet the Arabs in. I may also say that after Sir Herbert Stewart's first action at Abu Klea we received a telegram from Sir Redvers Buller, who, I think, we all know to be a thoroughly practical soldier, and who had himself commanded one of the brigades which fought in square in 1884, in these words: "Do not let them get a run at you unless you are in square." I do not suppose we are, any of us, so mad as to wish to employ these squares against trained European troops armed with artillery and

modern rifles, and I will therefore pass to the only other subject in this lecture on which I should wish to say a word. The question of tactical formation is of course a very important one, but I should never myself wish to lay down too hard and fast a rule. I hope that we shall never employ Generals who are not capable of being trusted to choose the best tactical formation for employment at the time, and I believe the British General Officers who will be employed in future wars are to be trusted to do that, and I think it should be left to them. As far as the British soldiers are concerned, I would echo every word that General Graham has said, that our infantry are to be trusted as well as those of any nation in the world. But there is one thing, Sir, that I regret to have to say, and that is, they cannot shoot. Nothing struck me more, perhaps, after our little fight at Kirbekan, than to see the whole faces of rocks, as big as the side of this room, spattered with bullet marks, bullets that could not possibly or conceivably have gone within 20 feet, 30 feet, or 40 feet of anyone at whom they could have been aimed. Of course we all know the enormous mass of lead that is fired away for every man that is killed or wounded, and what does that mean? It means that our soldiers are not trained to shoot as they should be. I would earnestly commend to my brother Officers a little pamphlet by a very able and intelligent Officer, Major Hamilton, of the Gordon Highlanders, Sir Frederick Roberts's first aide-de-camp, called "The Fighting of the Future," in which he puts, almost better than I have ever seen it, this question of the absolute necessity of teaching our soldiers to shoot. I do not know that I should go so far as he does in saying that thirty-five thirty-sixths of the time devoted to the instruction of the soldier should be given to teaching him to shoot, but to give him only one thirty-sixth of the time for shooting, as is practically now the case, must be altogether wrong. The question, of course, that we all have to consider with troops in action is how to sustain the *morale* of the soldier, or in plain English, how to keep up his pluck under a heavy fire, and I am perfectly convinced that there is nothing that would give the soldier such confidence as the knowledge that he could with certainty hit any man that was coming at him, that, in fact, if you gave him a repeating-rifle he could knock ten men down in a rush of 100 yards. If we could at once give him that absolute confidence that he with his weapon could not be approached, I believe we should then really and truly have the very best troops in the world.

Colonel STIRLING (Coldstream Guards): My lords and gentlemen, as a regimental Officer of many years' experience, and one who has paid great attention to drill, perhaps you will allow me to give the experience that is the outcome of my studies. Of course the great difficulty in the attack system against an armed force is to get over the dangerous ground with as little loss as possible, and to bring as many men into contact with the enemy at the final rush as you possibly can. The great difficulty of disciplining the fire of soldiers in open order is the loss of the command under which they started. At the same time, if the Drill Book be taken with a little artistic skill, we could get out of our Field Exercise an attack formation which seems to me thoroughly satisfactory. But I admit that it requires a slight amount of artistic skill. It is given in the Drill Book that you can either extend a company, half a company, or you can extend by sections. In the one case the half company has to cover the whole front of the original company, or the section in a weaker form has to cover the whole front of the company. Under these circumstances the moment you reinforce you immediately lose the sectional commander's absolute command. The men of two sections are higgledy piggledy under the different sectional commanders, therefore I would suggest that in all attack formations extending from the company and equally going on from the battalion, the first and the third sections should be extended, leaving the second and fourth sections in support opposite the gaps of those other sections. You will observe then the result is if men are dropping in the first section they will close as they advance on their directing flank; the second section will come up on their left intact, and you will by that means keep each section under the sectional commanders. And the sectional commanders have a large responsibility in the field, because the companies are enormously larger than any we are accustomed to drill with. If you want the fourth section to come up it goes on the left of the third, and the companies are then in line in sections, in the order in which they started,

and the absolute power of the fire discipline of the sectional commanders is not lost. I venture to think this a suggestion worthy of your consideration.

Captain C. B. Mayne, R.E.: My lords and gentlemen, the subject upon which I should like to say a few words is that of long- and short-range fire. No doubt advantage is to be got from long-range infantry fire when it can be employed under conditions which are favourable to its use. In an attack it naturally would not be used before the artillery of the defence had been silenced. Between that time and the moment when the actual assault takes place, there is a considerable interval; it is during this period, the artillery of the defence being silent, and the artillery of the attack being concentrated on the infantry of the defence, that long-range infantry fire should be thrown on the defenders' infantry. It is useless to fire at objects without depth at longer ranges, as far as I can make out, than 900 yards, and as General Harding has pointed out, it is between 900 and 600 yards that the best results are to be got by the moving troops of an attack, and that is practically long-range fire. In the defence, long-range infantry fire is best delivered from advanced posts, to compel the enemy to extend as soon as possible and so to suffer all the evils resulting from a premature extension before coming near the main line of defence, which should trust to short-range fire for actually repelling the assault. In savage warfare short-range fire is the thing. I saw some little firing in Affghanistan, and there long-range firing was not of the slightest use. An uncivilized foe does not appreciate long-range fighting; he considers the short ranges as his best ones, and he ought to be beaten at them, and not kept off by long-range fire, in which latter case his only thought is, "Let me get at them." General Brackenbury mentioned the bad shooting of our men in the Soudan at short ranges. I think that can be got over if we only made use of something more like the system adopted abroad. In the first place they sight their rifles for a full foresight. Our rifle is sighted for a fine foresight; the men cannot use it moving rapidly, and immediately they use a full foresight, as they cannot help doing, up goes the bullet high in the air. For all practical purposes I think the full foresight is one of the chief requisites for a military rifle. The second point is the point to be aimed at. We train our men to aim at the centre of a man's body; that keeps the bullet 3 feet higher above the ground than if you aim at his feet. The men will not adjust their sights, as a rule, under 400 yards; the Germans and all the other Continental nations accept this and do not expect their men to do it; they leave the 400 yards sight up, but make up for that by aiming at the enemy's feet. At that range the bullet is always under the height of a man. As we saw from the newspaper accounts in the battles in the Soudan, the Arabs were killed within 30 or 50 yards of the squares. If you draw a diagram under the conditions of not altering the backsight and of aiming at the centre of a man's body, with a full foresight, you will find that the enemy only comes within the power of the bullet at those identical distances; beyond them it goes over his head. I think that explains a good deal of our bad shooting in the Soudan,—the fine foresights. The men not altering the sights, and aiming at the centre of the body. If this system were altered, we should find the results of our firing in war-time as good as can be got anywhere else. The conditions of firing at a target and firing at an enemy in action are very different, and you cannot expect men to take such careful aim in action as they would when they are not exposed to danger. Consequently a full foresight is better adapted for war than a fine one.[1]

---

[1] It was remarked to the writer that men in action do not *aim*. This is certainly the case at short ranges, but the above remarks apply with equal force if we use the better word *direct*, instead of *aim*. If men are taught and accustomed to direct their rifles low, a better result will be obtained than if they get habituated to direct them high, as English troops are now taught. But men will aim at the longer ranges and at solitary individuals, and in such cases, the writer contends that a full sight is better than a fine one for many reasons, and that the backsight of the rifle should be graduated for it. In fact, to use a simile, for which the writer is indebted to Colonel Mackinnon, the difference between using a full and fine sight is like the difference between trying to read large and small print. As a

Major Bridge, R.M.L.I.: Having had the honour of serving in the late campaign in the Eastern Soudan, I wish to say a few words about the square formation. It seems to me as if the critics who are hostile to squares had overlooked this point, whether the square formation was used simply for fighting, or whether the square formation was used for protection of convoys as the primary object, and in this later case fighting being of secondary consideration. Now, both in the attack on Dhilibat Hill and at Tamai, when unhampered by being obliged to protect convoys, the square formation was *not* used. And above all, in the capture of Dhilibat Hill, the most ardent advocate of the attack formation as laid down in the Drill Book would have seen the principles there enunciated carried out in their entirety. Now, in such a country as the Eastern Soudan, a country intersected by khors and wadis, and also covered with thorn scrub, to have used any other formation but the square formation for protection of convoys would have been madness; above all, when one recollects the Hadendowas, who swarmed in the bush, a race who had no fear of death, and whose warlike and predatory instincts were aroused at the sight of convoys, and who made the most determined and desperate rushes to capture the tempting booty. Now, if the square formation is to be made use of, there are two points which might always be attended to: first, the breadth of the leading face of the square should be regulated by the number of animals you are convoying, for I take it all will agree that the object of a convoy is not to fight, but to get on, and the broader front you move with the easier this will be accomplished, and in a country like the Eastern Soudan, where water was absolutely essential, the getting on of convoys was of the highest importance. Secondly, the pace of the leading face of the square should be regulated by the pace of the animals, and this should be laid down. If thought necessary both these points might be laid down in the Drill Book, but at all events these points should be placed in Field Orders. In the present day one hears a great deal of teaching soldiers to use their individuality: now it seems as if this was most essential when on sentry, above all when one is in face of an ever active, relentless, and creeping foe like the Hadendowas. But the Drill Book is silent on this point, and all soldiers know how very little opportunity is allowed to soldiers to use their individuality when on "Sentry go." Although belonging to a service which in the present day is the only long service one, I must confess that nearly twelve months on active service have caused me to cordially endorse certain maxims in the "Soldier's Pocket Book," a book which I am sure all who have been on active service will agree is worth its weight in gold; these are, first, that short service soldiers, *i.e.*, from 2 to 12 years' service, are out and out the best, as after 12 years' service it seems as if a soldier's sole idea was to obtain a "lazy" billet, and to throw the more arduous work of actual soldiering on his younger comrade; second, the abolition when on active service of the rum ration, for whatever the beneficial effects of it may be, experience has clearly shown me that they are more than outweighed by the evil ones. Just now there is a good deal of controversy about another point—selection; now, of all points, the most essential at all times seems to be selection of Officers for all posts of command.

Colonel G. P. Evelyn: My lords and gentlemen, as the time allowed is exceedingly short I will confine my remarks to the point of the attack formation. In the lecture which we have all heard with so much interest there was a comparison made between the attack of a fortress and the attack of an entrenched position. I think this comparison might be carried further, as the same general principles rule almost

---

rule, men, even at target practice, use nearly a half sight, showing that a fine sight is perfectly impractical except for crack shots. The writer has made many trials with men using fine and full sights, and has found that practically there is no difference in the accuracy of the shooting, while the men very much prefer the full sight. But the most important point of all in action is to maintain control over the fire of the men. However perfectly the men may have been taught to fire, they will not aim in action unless a control is kept over their fire, and it is a point to be considered whether in any system of musketry instruction in the future, control over fire should not be made a higher object than mere target practice.—C. B. M.

every kind of military operation. It is somewhat curious that in the assault of a fortress, either by storm or escalade, the firing force is quite distinct from the assaulting force, whereas in the advance to the attack of an entrenched position it is proposed that the fighting line is also the assaulting line. Now, either one or the other of these must be wrong, and I am very much inclined to think it will be found that our attacking force should be made into two divisions, one to be called the firing force and the other the assaulting force. The firing force should have a similar duty to perform to that of the clouds of skirmishers who are sent to the edge of the glacis and counterscarp of a fortress to keep down the defenders' fire while the assaulting party advance. My knowledge of drill and military movements extends over a good many years, and I remember in the old days that we used to advance our skirmishers as we did at the Alma, and however successful those skirmishers might be, it was considered necessary, as on that occasion, to recall them before the line advanced. The skirmishers of the light division actually took possession of the enemy's entrenchments, but had to relinquish them on the "retire" sounding. Before the majestic line could advance it was necessary that the way should be cleared, and the skirmishers had to be recalled, and the men who were actually on the outward slope of the enemy's batteries were ordered to retire, and lost a great many more men in retiring than they had in taking the position; and then the second line advanced, and had more difficulty in regaining the ground than the skirmishers had had. Now it is evident that our system in those days was one of retiring skirmishers. If we were to assault such a position as the Alma now-a-days, instead of being so foolish as to bring back the skirmishers we should reinforce them. We have now, therefore, come to the system of reinforcing skirmishers, but I question very much whether that will be permanent. I think we shall still have to change. I think the skirmishers should never be considered as the men to take part in the assault. If a Division has to assault an entrenched position one brigade should be sent forward as the firing force, divided into skirmishers, supports, and reserves to keep down the enemy's fire, and after the fire has produced its effect, the second brigade should advance to the assault of the weakest points of the position, but this should not be till the enemy's position had been thoroughly swept by the fire of the first brigade. If that were the case the fire of the assaulting brigade would be thoroughly under control, but as a rule when soldiers once begin to fire it is difficult to get them to advance. I believe the firing force should keep up a fire as close as they can to the enemy's position, and there remain firing to cover the advance of the assault, who should not be allowed to load till they were past the firing party, and had got as close as possible to the enemy's position. I believe we shall have to make that change. It may seem strange, and it is rather hazardous, for me to attempt to support something different to our present system, but I believe that the system of making our men who fire also rush forward to the assault is a wrong one, that the assaulting column should be kept entirely distinct, and not fire a shot, if possible, till they are almost within bayonet reach. I believe if the rear rank were armed with pikes instead of firearms, and carried extra ammunition for the front men, the force would not lose much in efficiency. We fire too much now; too quickly and at too long a range.

Lieutenant-Colonel the Earl of DUNDONALD, 2nd Life Guards: My lords and gentlemen, there seems to be a favourable opinion with regard to the utility of the square formation under certain conditions against a badly-armed savage enemy, who charge home regardless of their lives. I consider that these conditions existed at Abu Klea. After the successful entry of the Arabs into the square at Abu Klea, that formation was subjected to a great deal of adverse criticism, but I do not think that the breaking into the square was due to that formation. I was in the rear face of the square, and will give shortly some of the causes which in my opinion led to the entry of the Arabs: First of all the right face of the square was longer than the left, in the square were something like 120 camels, this mass of animals being surrounded, as one may term it, by an envelope of men, and the left side of the envelope being shorter than the right there was a natural tendency for the camels to project in that portion of the square where there was least room for them. No doubt, also, there was some straggling, and with regard to this I would make a suggestion on the employment of native camel drivers in a square. It would, it is

true, have been very difficult, if not impossible, for sufficient soldiers to have been afforded at Abu Klea to lead 120 camels, but I do consider it a great disadvantage to have men in a square leading transport animals in large numbers who do not understand English. Also the native drivers sidled away towards the face farthest from where the bullets came from, and, unlike disciplined men, there was no proper order amongst them. There is one other point I should like to call attention to, and that is the difficulty in conveying rapidly the state of matters at the rear face to the front face. It was impossible to see over the mass of camels. I in the rear never saw the front face the whole time, and I would suggest that communication should be maintained from the rear face over the intervening mass of camels by means of signalling, using a long bamboo or other light wood as a staff for the flag. By this means the exact state of matters in rear could be immediately communicated to the front, and the pace and halts of the front face instantly regulated to suit the pace and requirements of those in rear.

General OLPHERTS, V.C.: My lords, ladies, and gentlemen, if I understand aright the reason why we have had this lecture from Sir Gerald Graham, has been partly because some strictures have been made on the use of squares by this most distinguished General in the late campaign in the Soudan. You are all aware that I had not any part in that campaign, I am sorry to say, and therefore, my coming forward to utter anything on the subject may be considered, perhaps, rather presumptuous. We have heard the views of several gallant Officers who were present in the Soudan, including General Brackenbury, for whom we all have the greatest respect as a soldier, upon this question, and it is probable that there are many other Officers here, old and young, who, like myself, were not there, and they may like to hear the views of an old soldier upon the late campaign. But you must remember, my lords and gentlemen, that I am a very old soldier (one of the unemployed), some may even think that I am on my last legs; and it is of course possible that this may be the last time that you will hear my voice in this lecture room. It was only the other day that for want of something better to do I was seriously contemplating forming square in my snuggery, leaving the defence of the outworks to the superior intelligence of my better half! Well now to be practical, having, as I think I have, enlisted your sympathies in my favour. There are two questions which I wish to put to Sir Gerald Graham. We have heard a good deal about the "impenetrable scrub," that you could not go through it, and I must confess that it has always puzzled me how you could move your square through that "impenetrable scrub." I do not understand a large force advancing to attack the enemy through "impenetrable scrub," in the form of a square, or even through a lane cut through the "impenetrable scrub," with no men on the flanks or anywhere else outside the square. That is simply one question that I propound. The next question is this: it has always been in my head, and I am sure it has been in General Brackenbury's, and I can't help thinking that General Brackenbury as an artillery Officer will sympathize with me in this question, though there are a good many others who may not do so. I am myself an old artillery Officer, and I have always thought—forgive me for saying so, it may be presumption—that more light horse artillery ought to have been used in the Soudan than was used there. I want to know why it was not used? You had your base at Suakin, and your ships there, whence you could land your artillery and horses, and I should really like to know why on earth you were advancing with those squares through that "impenetrable scrub" without horse artillery. When I was a young Officer I first of all learnt my work in the artillery, and there I used to practise my battery in forming a square. I learnt that from the old Royal Artillery Drill Book, but I carried it to great perfection, and I could form a square with my battery very rapidly indeed, in less than a minute. It was locked all round, and inside were determined men with their carbines and swords, and all that, and I should have been very happy to have received a good many of those Arabs upon one of my squares. I think if such batteries had been there they could have taken care of themselves, and if they had been at a respectable distance on the flanks, and to the rear, they would have made an impression upon those fellows in the "impenetrable scrub" without much risk to themselves or inconvenience to others. These are the two most important questions I have to put. I commenced by trying to enlist your sympathies with myself as an

old soldier, and I will try and conclude in a somewhat similar manner. When I was in India, and was stationed at Nowgong in the jungles, there was a regiment of cavalry and there was some artillery, and there was my old friend General Alexander Hardy Elliot, now commanding in Scotland, and who can corroborate what I am telling you. There was a sergeant-major of the cavalry regiment who went out shooting one day. He came back and described his experience. He said that he suddenly came upon a lot of wild pigs in the jungle. He had a knack of saying "If you believe me, sir," at the beginning and end of each sentence, and so he commenced his story—"If you believe me, sir, when the pigs saw me, if you believe me, sir, the pigs they formed square, if you believe me, sir." The moral of that is that some of the lower animals instinctively form squares when threatened by sudden danger!

Colonel GWYNNE, King's Shropshire Light Infantry: I think there is one point that has been entirely left out in the discussion, namely, the effect of long-range musketry fire on the reserves of the enemy. Granting all that has been said by General Graham as to the loss of effective fire in the attacking line, if it is forced too much, yet it seems to me there is a great deal to be said for the effect of the fire of an attacking force on the reserves of the enemy from a long distance. I have seen very long experiments in India both in field firing and at targets, and it was brought very forcibly home to me and to other Officers like myself, that the effect of this—I won't call it unaimed fire, but missent fire—would have been tremendous on the reserves of the enemy in rear of his front fighting line. I would suggest therefore for consideration, whether it would not be possible for the fighting-line to advance under the protection of bodies of infantry on the flank, who would be firing at the reserves of the enemy. I think there would be great moral force gained by that.

Colonel LONSDALE HALE: There are a great number of us here who I am sure have come to learn, if we can, the results of practical experience in the field. There are a number of Officers present who were out in the Soudan, and who have had that practical experience. One of the points upon which we are all most anxious to obtain information is fire discipline, and if those gentlemen who have lately been fighting in the Soudan and elsewhere will, instead of offering us theory, kindly come forward during the remaining portion of this discussion, and tell us from their own experience how the British soldier, armed with the breech-loading rifle, is to be brought under fire discipline, they will be conferring a great benefit upon those who listen to them.

Major GUNTER, Garrison Instructor, Dover: As intending speakers have been requested to confine themselves to the points specially noted for discussion at the end of the lecture, I will confine myself to the first point mentioned, the training of the men, and will not detain you more than a few moments. I merely wish to observe that the group system advocated is excellent, but it requires constant practice on the part of Officers and men. Thorough efficiency can only be secured by the men being constantly exercised by thoroughly trained company Officers. I think that the training of the men must be more than ever confided to the company Officers, and that every facility should be afforded by the authorities for this, which we have seen of late they are anxious to do. I think also that, if possible, company Officers should be given more men to carry out their training with. I will not detain you further, as there are, no doubt, many Officers of greater experience than myself who wish to address the meeting.

General Sir MICHAEL A. S. BIDDULPH, K.C.B.: My Lord Wolseley and gentlemen, as regards the interesting lecture which we have had from our distinguished friend Sir Gerald Graham, I should like to make a few remarks on the subject of the training of the soldier. I must agree with General Brackenbury in the opinion that the British soldier is not a very good shot, and that every endeavour should be made to improve his shooting. This, I think, is to be effected according to the suggestion which we have just heard from a speaker opposite to me, viz., by handing over the company as much as possible to its commander, and making him the chief drill instructor of the body of men under him. I should like to observe that the shooting of the enemy, such as a Zulu or Arab, is very much like the shooting of a snipe, or the shooting of any wild animal. You have very little time to think about how you are to do it, and how you are to have your piece exactly aimed at

this wild creature. The action of the soldier is very much the same as that of the sportsman. The soldier has to aim and fire at appearing and disappearing targets, at targets moving towards him and from him, and right and left of him, and as of course it is almost impossible for anybody to alter their sights during the interval when the enemy is crossing the last 300 or 400 yards, our men should be taught to deal with that part of the range by appreciating the distance without touching the sight, and this is really the practice now, and I only lay emphasis on this point. As regards one more question, if I may be allowed to change the subject. In the attack of a position I agree with the lecturer that the artillery should be placed well on the flanks, and that due opportunity should be given to it to reduce the power of the defence, and that they should be associated with large bodies of infantry, if such can be spared, to assist in such reduction, and that when it shall be reported or considered that a sufficient impression has been made on the enemy that then the attack should be launched. I also agree that independent rushes should be as little as possible resorted to, but that the men should be brought up to a close distance by superior command, firing little, if at all, the struggle being decided as much as possible at the last by the bayonet.[1]

Colonel Sir Lumley Graham: My lords and gentlemen, I only speak for the purpose of eliciting information, because I am one of those who only stay at home and remark upon what is done by our gallant friends who are fighting abroad. But I was one of those who, when we read the accounts of the battles from the Soudan, were inclined to doubt the advantages of the square, not from a defensive point of view, but when used offensively. I could not help thinking—and I am going to end what I say with a question to our gallant lecturer—that if instead of putting the whole force available into the square or squares, a part of that force could have been used so as to act independently, the offensive movements would have been much more practicable and effective. If General Graham will allow me I will deal with one particular case in which he held the command, at that grand action in which everyone behaved so splendidly—Tamai; if I understand the position correctly, his two squares had to advance over an open sort of plateau right up to a deep donga or ravine, which deep donga was full of the enemy. If I understand the ground rightly, there was a possibility of turning the flank of that donga. I should like to ask General Graham whether, with his now complete knowledge of the character of the enemy and of everything that has happened since that time, he thinks it would have been possible to have used a part of his force, say in the form of double companies, each double company acting independently, as they would in attack formation against civilized troops. I do not mean to say necessarily in extended order, that might or might not be according to circumstances, whether, I say, these companies might not have been used to turn the flank of that donga so as to facilitate the action of the advancing columns or squares. In fact, my own idea about this question, which I submit very humbly to those who have had practical experience of the matter, is that only a sufficient portion of the force should be kept back for the purpose of acting as a baggage guard in the shape of a square to protect the impedimenta, and that all other troops available should be used for offensive action in handy and pliable formations. With regard to what General Graham has said upon fire discipline, also upon the use of groups, I was very much struck indeed. I am sure that the group formation is of the utmost importance. By using the group formation as in Germany, and as Captain

---

[1] I think from the reply made by Sir Gerald Graham to my remarks that he did not quite realize my imperfectly expressed simile; the fault may have been mine. I maintain that an advance of savage and athletic warriors, such as has been frequently made of late years on our troops, appears a very difficult and constantly moving target for the men to hit, and that instruction should be devoted to teach success in dealing with such an enemy by fire as he approaches. I should like to observe that the most able riflemen known, the Boers and Swiss, are superior to the rank and file not only of our own Army, but of every other. I did not make this remark in reply, as the hour was late, and I thought it might well find a place as a note to my speech.—M. A. B.

Mayne points out so brilliantly in his book, which I have read with the greatest interest, you are enabled to get over a great difficulty that exists in warfare of the present day, that of controlling your fighting-line, because when the Captain has formed a sufficient number of group leaders he can depute the command of certain portions of his line to them.[1] Then with regard to fire discipline, that of course is one of the most important subjects of the day, and I was delighted to hear General Graham draw attention to it in the forcible way in which he did. We all agree upon the point that it is necessary to make a soldier shoot well, as a *sine quâ non*, but we are not all agreed exactly as to the way of doing it. I think, however, that there can be very little difference of opinion on the fact that one of the most important branches of the soldier's firing education has been very greatly neglected by us at home. It has been carried out to a far greater extent in India. I refer to field-firing. We want plenty of that, not only to train the soldier to shoot, but to promote fire discipline, and to teach the Officer how to handle his men under fire.

Colonel GORDON IVES, Lieutenant-Colonel Commandant 18th Middlesex Rifle Regiment: Perhaps I may be permitted to add a few suggestions that have occurred to me, and which I submit to your consideration in all humility. For more than twenty-five years have I been devoted to this subject. I cannot but think that we should examine our instruction books, and see if the first stages of our training are correct. Look into our drill books, and it is easy to perceive that there are two distinct drills taught, each on a separate principle to the other. There is the old drill founded on the wheel or part of a circle, and there is the more modern drill chiefly on straight lines. It is most difficult to teach the young soldier the distinction in a short time between the two. Moreover, I venture to think that in both systems and in all our drill books there is a tendency to teach the very thing we do not want done. The men are taught to keep together, to touch not in mind but in body, and thus they are taught to do what is certainly not difficult but natural to them, all men and animals being inclined to crowd together in danger. But to crowd together to-day is to be destroyed. Surely what we want is to teach men to keep apart, to keep away from one another, and yet to remain together with as much cohesion of movement as is possible. A method of carrying this training out occurred to me when shooting some years since in Germany, and it is this: fall in on parade at all times in four lines—each line of which is a section—each section divided in groups of eight men under a non-commissioned officer, the men standing 30 inches apart. The advantage of this is that standing on the same space you now do, you avoid telling off altogether, and you have the men completely under control. But its really greatest superiority consists, I venture to submit, in that you have your front line ready to commence an attack at once, easily placed in the proper direction, and you avoid that difficult and dangerous movement of having to extend men in the proper direction at a time when they are most excited and most difficult to control. All the most valuable works on training in all countries attach great importance to this. There are many here who must have seen over and over again how liable men are to extend wrong. It is so late that I will conclude. I have given you my idea, to work it out more in detail would

---

[1] One at least of the audience having misunderstood the meaning which I wished to convey in this sentence, I think it well to make that meaning clear. Far from wishing to reduce the tactical influence of the Captain in battle, I feel as strongly as any one can feel the necessity of extending that Officer's powers both in the field and in quarters as far as is compatible with the due exercise of the battalion commander's authority over him, and I would even give him more importance than he ever can possess under our battalion organization, by adopting that which prevails in all the great Continental armies. But as with the present system of tactics in civilized warfare the Colonel can only direct his battalion in battle through the action of his Captains, so the latter can only control their companies efficiently when in the fire-line through the action of their section and group leaders. It rests then with the Colonel to form good Captains, and with the latter to form good subalterns and non-commissioned officers to lead their sections and groups.—L. G.

take too long, I could speak for two hours on it, but I will only thank you for having so kindly listened to me.

Colonel Right Hon. J. H. MACDONALD, Colonel Commandant Queen's City of Edinburgh Rifle Volunteers: I should not have spoken, as I wished to hear from experienced Officers in the room their views with regard to the different points of this lecture, had not the Officer who has just sat down alluded to the proposals that in my humble way I have made upon this subject. He will forgive me for mentioning to him that the very thing that I have always stood up for most strongly is that men should fall in in four-deep formation with arm's-length interval and without any telling off, and that the strength in men should be known by the number of their sets of four, or rather, as I should prefer, by the number of their groups of eight. The enormous advantage of that is this: that whatever the force may be that you put upon the ground, 12, 18, 20, 40, or 100 men, your mode of action is exactly the same in moving to the front. There is one objection made by the lecturer to that idea, and one only as I understand, and that is, that it gives you a support and a main body, or what I would rather call a first reserve than a main body, it gives you them within the same unit, and he objected to that on the ground that if they are of the same unit, they are not available for the purpose of being moved off to the flank for any purpose that may be required. I make two answers to that. In the first place, that same objection applies equally to dividing a company, cutting it into four lengths, into sections, and splitting up one section—skirmishing—following with the others. You equally in that case have to move those who are supporting the first section out of the fighting line, and equally break up the tactical cohesion if you move support or main body to a flank. The other answer is this: I think that some of the most eminent military men, whose works I have read, and whose statements in this theatre I have heard, say that no force for the purpose of making a front attack should be allowed to be in any doubt or fear about its flank. We all know that in modern warfare there should be no excuse whatever for a force sent out to attack being surprised upon its flank if proper provision be made beforehand for protecting its flanks.[1] I should be glad if the lecturer would kindly answer one or two ques-

[1] Referring to Sir Gerald Graham's observations in reply, I would like to say that it is of the very essence of the four-deep system that each rank of fours is a tactical working unit. They are in fact the true sections, the "groups" for work, while the eight men of each double-four are more the molecules of which the eight atoms have an attraction of cohesion, so that there is a tendency to recovery of cohesion, in spite of the necessity of an order with intervals, and a greatly increased rapidity of recovery of order from the necessary confusion of the final part of the engagement. If there is recovery of the unity of the small molecules, the sortation of the mass is made infinitely easier. This has been tried, and the result was a success beyond expectation in going through the roughest ground. As regards the mode in which the supporting ranks of fours are to be moved forward, they are not to be moved as the lecturer supposed, in a "loose formation," but exactly as suits the ground and the circumstances. It is intended always, even when drilling on flat and open ground, to practise Officers in moving these supporting portions of the company in forms suited to ground described, such as through a wood, over undulating ground with cover, fenced ground, &c., &c.; the general principles applicable to different circumstances being laid down, and the Officers instructed as to the best form, or absence of form, to adopt. They would then be left to themselves during the advance and reinforcement, and given complete control of their men, to bunch them or thin them out, or file them in a "follow my leader" fashion, according to the ground they were supposed to be on, and the supposed direction of artillery fire, &c. They should here comment on what they had done, that errors of judgment should at the close of the forward movement be pointed out, not in a way of fault-finding, but instruction. At present all our attack drill on the flat is mere form, and impresses the mind with the idea that supporting bodies are to be moved with the same exactitude and absence of change of form as a company on parade, and neither Officers nor men are really taught how to act. As regards moving to a

tions which occur to me as an amateur reading the accounts of the war in the Soudan. The first is this: on the occasion when a severe attack was made by strong bodies of Arabs for the purpose of breaking into the square, I want to know whether the fire discipline was conducted in the way of working the firing as independent firing, or whether it was entirely by volleys. And I may say one would like to know which of those plans Generals who have been in the field would prefer systematically to use. Of course, I do not say that under certain circumstances one might not be preferable to the other, but I should like to ask whether a succession of volleys were used, or whether it was attempted to crush the attack by continuous and independent firing. The other point is this: whether in the formation of a gigantic square for the purpose of acting as a convoy, or when in consequence of the nature of the ground and the enemy you had to meet, the square formation is the best, whether it would not be advisable to have inside the square something of the nature of a separate force, not forming part of the sides of the square. I ask that question for this reason, that it must be perfectly obvious to every one, if these savages, coming in the form of a dense mass, do succeed in reaching the face of the square and getting close up to it, still more if they are able to push it in to any extent, the firing of your own square becomes a very dangerous and difficult operation for your own men, because firing at Arabs or other savages who have pushed in the fighting face of your square, you are very apt to kill your own men as well. I would ask whether some physical force might not be free in the square for the purpose of keeping the square out, if necessary, by actual mechanical force, so as to leave the men more free to fire upon the enemy outside.

Sir Gerald Graham: It has given me great satisfaction to hear so many Officers get up and make comments which I may consider generally favourable to the views I have expressed, and in all cases these comments are of great value. I would allude more especially to Major-General Brackenbury's remarks. He is a great authority on this topic, having just come himself from the Soudan, where he has had an opportunity of seeing the nature of the enemy we had to fight with. Taking the question of squares first, I think that the only remarks that are called for from me are with reference to Colonel Macdonald's inquiring as to whether there should not be a reserve in the square. I perfectly agree that there should; and I should certainly advocate having something like double companies on the flanks, so as to have an interior force independent of the outside line; and, in fact, that suggestion struck me as a very good one, because you could bring them out if required and develop your front. One does not think of all these things at the first, but if we had to fight again in squares I should do that; and, in fact, at Abu Klea we understood there was a reserve in the square. We were accustomed to consider that nothing could break a British square, and therefore we did not take steps for such a contingency. Still it would certainly be desirable, not merely for that object, but for the purpose of developing the fire, to have something in the nature of a reserve in the square. Our object in the square was to cover the baggage animals, and we generally found we had not any men to spare after doing that. Camels and baggage animals are apt to straggle, and their loads break down; the result is the squares get extended, and you find you never have men enough to do the work to keep a complete guard all round your baggage animals. We did not consider the square as a fighting formation, but as a defensive formation for the convoy. I am very glad to see that squares are backed up by an Officer of such long standing, and whose gallant deeds are so well known, as General Olpherts. He asked how we could manage to get through the "impenetrable scrub" with a square. Well, I should say we could not, nor in any other way; but I never used the expression, and therefore I am not responsible for it. The scrub was not "impenetrable" as we proved by getting through it.[1] I quite agree with him as to

---

flank, I refer to what was said above, space does not permit me to enter into that matter, but I can only assure the reader that it has not been forgotten, and creates no real difficulty.—J. H. A. M.

[1] General Olpherts was, however, quite right. I *did* use the expression "impenetrable."—G. G.

the great advantage of horse artillery; we had a battery on the last occasion, and therefore I can speak personally to their use in the Soudan. Colonel Macdonald asked what was the nature of the fire we used in the squares. It was not always the same. At Tamai, as you are aware, the second brigade was firing independently; the fire of the first brigade was by volleys. At El Teb the firing was independent. Firing by volleys I consider infinitely better. At close quarters it is vastly superior, enabling the commander to maintain discipline. As regards the group system in extended order, Sir Lumley Graham mentioned the great advantage of its relieving the commanders of companies from the almost impossible duty of giving orders to the whole extended line. I do not know that I quite apprehended Sir Lumley Graham's meaning, but I am inclined to think that those commanders of companies in most cases would still retain control by means of the agency of the group leaders.

Sir LUMLEY GRAHAM: That is what I meant to convey—my words probably did not convey my meaning—they would facilitate the control of the companies through the action of the subordinate leaders.

Sir GERALD GRAHAM: I consider that one of the most important duties of the group leaders. They do not take the control out of the Captain's hands, but enable him to exert it. Sir Lumley Graham asked me another question with regard to the fighting at Tamai. Of course if I had known exactly where the enemy were, and what I know now, I might have acted differently; but at the time we advanced on that khor one certainly did not know that we were so near to them. In the next place we fully intended to take them in flank. My information led me to suppose that the enemy were more to my right. I went to the left with the intention of taking them in flank, but they must have moved up to the left also. The result was, we came upon them very unexpectedly. It is ground you cannot see. You may be close to a khor and yet not know that you are there. The ground is very rocky, and at the entrance to the khor was extremely precipitous; you might come within a few yards of it without seeing it was there. No doubt we could do better if we had perfect information, but it is impossible to get that information. I am glad to see that an Officer of such great experience as an artillery Officer as Sir Michael Biddulph approves of co-operation with the artillery. He also expressed my own opinion strongly as to the necessity of fire training being conducted by the company Officer. I cannot agree with him in his allusion to snipe-shooting. I am afraid we could not train a soldier to be a good snipe shot,[1] that is rather too high a standard. What we want is to make him obey orders in action, and if he will at the shorter ranges keep his sight up to 400 yards and fire steadily and coolly, he will do just as well as if he was an accomplished shot; whereas at the longer ranges he must take his orders from his commander, and not fire wildly on his own judgment. I think our system of musketry instruction should rather be regulated with a view to enabling soldiers to act coolly and steadily and take orders in action, than to make them good shots. A certain extent of good shooting is absolutely necessary, but it should not extend beyond the shorter ranges, say 600 yards; trying to make a soldier shoot at longer ranges, and imagining that he could get such dexterity with his weapon that he would be a good snipe shot is, I am afraid, going beyond our powers. I quite agree with what Major Gunter has said on the group system: it is not a thing that can be taken up readily in the field. It is a system that requires constant practice and training by company Officers, and I endeavoured to express that opinion in my lecture. I am afraid I have answered very imperfectly the various remarks that have been made. Captain Mayne, who is most competent to speak on this subject, has restricted himself to the great advantage of having a full foresight and aiming at the feet. I agree that the latter is a detail of musketry training that should be generally adopted. Some tactical points have been entered into by two or three Officers, and I think I understand Colonel Stirling's proposal to be that the first and third sections when extended should close to their right, and

[1] I fear that I misunderstood Sir Michael Biddulph, who only meant "snipe-shooting" to be taken as an illustration of the rapid aiming and quick firing required from men in action. I quite agree with the view, as I have already expressed in my lecture.—G. G.

the second and fourth sections should come in on their flank. That would quite agree with my views upon the subject, and where you have those two sections extended I think that would be a very good proposal. I quite think it would be a very good thing to have men directed to close at a certain point, whether to the centre or to the flank, and that the supports should know where to come to. Colonel Macdonald made some remarks on his own system. I confess I am unable to agree with any system which brings up supports and reserves in a loose formation. It appears to me you should keep them together at starting, and that they must be tactical sub-units. If Colonel Macdonald means that his four lines are tactical units then I should agree with him so far. I am afraid that the formation could not be maintained on broken ground, but I may be wrong. It is one of those points that I do not pretend to enter into, but I am very glad to get information upon them.[1] I have already stated in my lecture that it is a modification of the wave system, which is advocated by Skobeleff, and therefore it is one that I say should not be lightly rejected. I would conclude by thanking all who have taken part in the discussion, and those who have done me the honour to listen to my lecture, and you, my lord, for kindly presiding on this occasion.

General OLPHERTS: With regard to what General Graham said concerning the phrase that I used of "impenetrable scrub," I beg leave to withdraw that phrase and to substitute for it Sir Gerald's own term "dense scrub," but I am still unable to understand how a large square could be moved through a "dense, thorny scrub."

The CHAIRMAN: Ladies and gentlemen, it is a very late hour of the evening. The discussion has been prolonged considerably, and it is not my intention therefore to go over the various points which have been so ably discussed. I am sure we are all deeply indebted not only to the lecturer but to those who have taken part in this discussion. Very useful information has been conveyed to us, and I think I am justified in saying, certainly in one instance, that it has been conveyed to us in a very amusing form by one whom I am very glad to see here and to meet again; I have met him upon many occasions in former years under very different circumstances and in very much more exciting times. Allusions have been made to the criticisms which were published when we were absent from England upon the formations that had been adopted by the various General Officers who had the command of troops in the field. Of course it is very natural that all military actions should be criticized, and when criticisms come from Officers like my friend Sir Lumley Graham and others, who are entitled to express their views and opinions, I think such criticisms not only do no harm, but do a great deal of good to the Army as well as to those who have been actually engaged in the operations concerned. I confess I have read some of the criticisms myself when in the Soudan with a great deal of amusement. Some were very foolish, silly, though some were worth reading; but I think, if I may venture to draw a comparison between them, the silliest of all that I read were the criticisms in "Blackwood's Magazine." I do not know who wrote them, and I should be sorry to know the name of the author, for they were evidently the ideas of a very theoretical gentleman who certainly had taken very little part in war, and who most certainly had never seen a Soudan Arab, or been in a Soudan desert. I shall not say much about the square formation beyond this one fact—and I only refer to it because I think General Graham has omitted it—that when you have to fight for your lives, as you have when you are cut off in a desert far from all possible aid—for you must remember what the Soudan deserts are, Abu Klea was 150 miles from all help—when you are entirely cut off from all possible help you have to go into action with the knowledge that unless you win you die. There is no half measure; you must win. You have to think of your soldiers and the *morale* of your soldiers, and unless you make your soldiers feel that should they be wounded they will be well taken care of, and will not be left on the desert to have their throats cut by the first Arab that meets them, I do

[1] I meant to say that I have no practical experience of this system. My theoretical objections are: the difficulty of keeping the supports and main body in hand, and the impossibility of moving them to a flank.—G. G.

not think you can expect to get the most out of them that they are capable of giving you. That is a very important point, for it is only by the use of the square formation in such a desert that you can ensure the protection of your wounded. I should call the advance in square formation a defensive-offensive operation; that is, you go into action knowing that before the actual hand-to-hand phase is reached there will be a certain amount of fire entailing the loss of a considerable number of men; but the vital thing you have to think of and to prepare for is, that determined charge of a body of fanatics who come upon you determined, if they cannot win, at least to die. Such a charge is nothing like a charge of cavalry that can be well met now by determined infantry in line. Any-one who has ever seen a charge of cavalry knows very well that after all the man who rides the horse has nerves and a heart, and that if he is met by stubborn resistance nine times out of ten he will sheer off before he reaches the square: he won't go in straight on the square, and his horse very likely won't face the bayonets. But these Arabs who charged our squares were determined to get at the squares. It is all very fine to say you ought to have received them in line, and if you had they never could have reached that line, but all I can say is that they actually did charge and were fired upon and did reach our squares; and if they reached the square I imagine they would have reached the line. The square was a defensive-offensive formation. It received a determined charge, and the moment the charge was delivered and the enemy beaten back, the men composing it were then free to act according to circumstances; they might deploy or adopt any formation that was thought necessary or advisable in that moment of victory. So much as regards the square formation. General Brackenbury has made some remarks to which I attach the very greatest importance, because as you know, gentlemen, he assumed command of one of the two columns into which the offensive operations were divided in the recent campaign up the Nile, after the death of my great friend General Earle, and he conducted them in a manner that was not only creditable to himself but to the fame of the force he commanded. I think he has been a little too hard upon the British soldier as regards his firing. I confess that that is not my experience. Remember that after all good shooting is relative. If you compare a man who can shoot 99 woodcocks out of 100 shots with a man like Tommy Atkins, or any man you pick up in Whitechapel and teach to shoot for two or three years, of course there can be no useful comparison at all, but if you will compare the shooting of the British Army with that of any other army in the world, I think we can hold our own. I think we shoot quite as well, as far as I have been able to examine the histories of the shooting of other armies, as the armies of any other nation. Of course you can teach some individuals to shoot remarkably well, but taking a mass of men, because an army is a great mass of average men, I believe out of every thousand soldiers you examine in any army, you will find that 10 per cent. cannot even see at 1,000 yards, much less hit an object at that distance. I am really not exaggerating; they certainly could not, I believe, see a man on horseback a thousand yards off. Therefore to talk of making every man a good shot in our Army is practically impossible. However, I do not at all wish to say that we have no room for improvement as regards shooting, and I hope that as years go by an improvement will be effected. I think the Army shoots better this year than it did last, and much better than it did five years ago, and as we go on developing the system of confiding to the company Officers the duty of teaching their own men, the better men will shoot. Reference was also made to the subject of ammunition, and we have been told that the advantages to be obtained from long-range firing are rather exaggerated. I have no wish to go into this very long subject, but I confess that I do not agree with those who attach no importance to long-range firing. I believe myself that long-range firing properly used, and used by men firing volleys who can fire without interfering with the first, or as some call it the shooting line, aided and assisted by machine-guns, will render it very difficult indeed for field artillery, to hold its own against such a description of fire. It is a fire that does not require the very careful training that accurate shooting at short distances does. I wish I could ascertain how many of those who are here have ever shot a moving stag at 200 or 300 yards. I am certain that many of those whom I have the honour to address have in the days of

their youth often without success shot at men at long ranges; I confess that I have seen many an excellent snipe-shot miss over and over again a man at 200 or 300 yards distance. Shooting a man at 300, 400, or 500 yards is a very different thing from shooting at a target; it is not so easy as people generally imagine. I have often heard people say "What very bad shots that regiment is composed of; see, there is a man running away at 500 or 600 yards off, and they have all missed him." I should like to have seen those critics firing themselves, for had they done so, they would have found that shooting an individual man in action is not so easy after all. As regards quantity of ammunition and our being afraid of long-range or any other description of firing, because it would exhaust our supplies, all I can say is, it is the bounden duty of those who have the management of our Army to take care that the British soldier may and shall have an unlimited supply of ammunition to fire away when the day of action comes, and when you do this for him, I believe, as General Brackenbury said, you have every reason to feel confident that he will make very good use of it. As it is so late, I will say nothing further, but will convey our best thanks to the lecturer and also to those Officers who have taken part in this discussion.

Friday, March 5, 1886.

Admiral Sir F. LEOPOLD McCLINTOCK, Kt., F.R.S.,
Member of Council, in the Chair.

AIDS TO NAVIGATION: STATIONARY AND FLOATING LIGHTS, WITH A DETAILED DESCRIPTION OF THE FOSTER COMPRESSED GAS SYSTEM, AS APPLIED TO LIGHT TOWERS, BUOYS, TORPEDO AND SUBMARINE BOATS.

By H. G. Huntington, Boston, U.S. America.

"Naviget; hæc summa est."
Virg. Æn.

The Chairman: Ladies and gentlemen, instead of the lecture which was to have been given by Admiral Arthur "On the Results of the Naval Operations in Berehaven," which has been postponed, we have to-day a lecture "On Aids to Navigation; Stationary and Floating Lights, with a detailed description of the Foster Compressed Gas System, as applied to Light Towers, Buoys, Torpedo and Submarine Boats," by Mr. Henry G. Huntington of the United States. This is a highly interesting subject to many of us, and although few people have had sufficient scientific education and practical experience to be able to grapple with a great deal that is to be said, I yet hope that in the audience whom I have the honour of seeing before me there may be some who are sufficiently acquainted with this matter to raise upon the lecture an interesting discussion. The subject of portable gas is not a novel one at all; it has been raised many years since. When gas is cut off from the generator and highly condensed it becomes conveniently portable, and therefore it is now coming into rapid use for lighting the beacons and buoys along the coasts of this country, and of a good many other countries also. I have no doubt that everyone in this room is aware that the Corporation of the Trinity House is constantly engaged in improving the lights along our shores, and that it has only recently concluded a most exhaustive series of experiments for the purpose of arriving at the proper value, as an illuminant, of gas, of oil, and also of electricity. But besides being valuable as an illuminant in our homes, gas has another peculiar feature,—it contains so much condensed energy in itself that, in this respect, it can be aptly compared with gunpowder. I will not further encroach upon your time, but will now ask Mr. Huntington to read his paper.

From the earliest times the nations of the earth have appreciated the aids to navigation afforded by lights on important headlands as guides to harbours or warnings of dangers.

The first lighthouse in the world was the famous Pharos of Alexandria, of which the ruins may be still recognized. Pliny informs us that it was built by one of the Ptolemies, about 285 B.C. It was of white stone, square, of many storeys, and diminished upwards to a height of 512 English feet. It cost nearly 200,000*l.* sterling. The fires lit in its highest storey were visible, Josephus says, about 30

miles. The Romans had full knowledge of the usefulness of lighthouses, and not only in their own country, but wherever they conquered other nations, did they establish these aids to navigation.

Without following farther the history of lighthouses through the middle ages up to our own time, it may perhaps be suspected that the number of wrecks in proportion to tonnage is greater now than then. This, however, is a simple conjecture that cannot be decided and of no practical importance. Probably no countries in the world possess finer systems of lights than Great Britain and France, yet in these days when all quarters of the globe are constantly visited by the world's commerce, an enormous quantity of wrecks occur that might be prevented were more care taken to protect navigators when in dangerous waters.

Light-vessels with a crew of men aboard, beside their first cost are a large annual expense, and their great bulk renders them dangerous and difficult of management in typhoons, hurricanes, and heavy seas. They have been frequently carried away, dragged from their moorings, or broken their cables, and during absence from the danger they were intended to warn navigators off, disastrous wrecks have occurred. Every landsman knows it is not the open sea the mariner fears, but the approach to land, and in the careful statistics of wrecks by the Board of Trade, we find that in the nine years ending 1883, out of a total loss of 15,569 lives including crews and passengers, only 1,334 occurred by vessels foundering, while nearly one quarter, or 3,580, occurred through strandings. The balance of total loss in this period was made up of collisions, missing or other causes.

We find that out of the total registered tonnage of the same nine years nearly 33 per cent. were totally lost. For example, in the whole number of registered British ships at home and in the Colonies, out of a total registered tonnage of 8,406,251 tons, 2,717,725 were totally lost. At this rate the whole registered tonnage of Great Britain and her Colonies is lost each generation. The country in the end has to bear these losses, and shipowners are heavily taxed in the premiums they are forced to pay for insurance.

In the present depressed state of the shipping trade these burdens are still more acutely felt, for in prosperous times the profits compensate in a measure for such charges, while at present the enormous outlay incident to shipowning makes that business not only unprofitable but ruinous.

Economy and efficiency are the present studies of all Governments and private undertakings, and so convinced have the authorities in this country been of the value of a serious study of various systems, that experiments were ordered by the Board of Trade at the South Foreland, to test the merits of lighthouse illuminants.

Until the present time, no Government has undertaken so valuable, thorough, and exhaustive experiments in regard to the penetrating power of light in all conditions of atmosphere, as these which have been carried out by a Committee of the Elder Brethren of the Trinity House during the past year. In their report we have been presented with most carefully compiled and exact statistics by the first authorities on light

in the country, whose observations extended over so long a period, and were so conscientiously made, that their results may be considered as having successfully answered the problem they were instructed to solve as to the relative merits of electricity, gas, and oil. The general conclusion of all these experiments has, however, demonstrated the utter inefficiency of even the strongest light known to the present time, in a dense fog.

From the above report we learn that on the 17th of May, 1884, from 1 A.M. to 3 A.M., "a thick and homogeneous fog" completely obscured the electric light at 1,900 feet, oil at 1,700 feet, and Wigham's gas at 1,400 feet.

Here we have electricity with a force of 1,500,000 candles, through cylindrical belt and vertical condensing prisms giving only 500 feet better results than Wigham's 108-jet gas through a Mew Island lens, whose illuminating power in a clear atmosphere is put at 59,000 candles, and while the electric light is nearly twenty-five times as powerful as the gas, its powers of penetration in any condition were not shown to be as great in proportion, and Mr. Vernon Harcourt's statement as to the superior penetrating power of gas light over electricity of equal candle power is fully confirmed by these experiments.

It is proposed in this paper to deal more particularly with the question of gas-lighting as applied to lighthouses and buoys, as the report of the Committee has clearly demonstrated, that when properly developed, Douglass's gas burners used, and processes adopted that offer greater economy in its production and greater purity and brilliancy in its quality, gas is destined not only to largely supplant oil, but can be made superior in penetration to equal candle-power electricity, whose first cost and subsequent maintenance exceed in a marked degree the first cost and maintenance of a gas station, as described in this paper.

This is easily seen by referring to the table of comparative cost of lighthouse illuminants prepared for the United States Government, and showing the relative cost of lard-oil, petroleum, and coal-gas.

The only gas besides coal-gas used by the Trinity House Commission was that made from petroleum by a German process, the light from which, on the Metropolitan Underground Railway and on some Continental lines, cannot be considered an unqualified success.

The gas tower used in the experiments at the South Foreland was marked B, the electric light tower A, and the oil tower C. In the C tower gas pipes also were introduced up its centre column, and laid to each trimming stage, so that burners might be readily attached to them, and both different kinds of gas and burners compared with those in B tower.

There were submitted three specimen sets of burners, two of the Douglass pattern, one six-ring $5\frac{5}{8}$ inches in diameter, its flame condensing to $3\frac{3}{4}$ inches in the focal plane, and the other $8\frac{5}{8}$ inches across, compressed to $5\frac{1}{2}$ inches at focus; two of the Siemens regenerative pattern, one producing a flame 10 inches in diameter and 6 inches high, the other a smaller flame 4 inches by 4 inches; and one Sugg six-ring burner, with a cylindrical flame $7\frac{1}{2}$ inches in diameter,

controlled by a cylindrical glass, $8\frac{1}{2}$ inches in diameter and $8\frac{1}{2}$ inches high.

These burners were carefully tested, with the result that the Sugg burner was discarded from the lighthouse lantern because evolving too large quantities of smoke, and the smaller Siemens burner was decided to give too little light to be useful in a lighthouse.

The comparative tables of these burners will be found later on marked B.

But to continue the comparison between gas and electricity, the following table taken from the Trinity House Report and marked A will be found useful. In notes to the next table, not shown here, we find that "for fixed lights in all kinds of weather the gas is generally superior to oil."

TABLE A.—*Showing Comparison of Electric Light by Eye-measurement with highest powers of Gas and Oil, both Revolving and Fixed. The assumed value of the Electric being* 100.

Number of observations in clear weather.		Electric.		Average of recorded values.				Percentage of superiority of			
				Gas. Quadriform 108 jets.		Oil. Triform 6 wicks.		Electric over gas.		Electric over oil.	
R.	F.		R. & F.	R.	F.	R.	F.	R.	F.	R.	F.
38	42	Single..	100	73	61	67	54	27	39	33	46
190	98	Biform .	100	65·25	61	60·25	53	34·75	39	39·75	47
79	23	Triform	100	63	70·5	60·3	68	37	29·5	39·7	32
307	163										
Number of observations in weather not clear.											
29	3	Single..	100	70	80	66·6	72	30	20	33·4	28
126	40	Biform.	100	72	58	68	49·25	28	42	32	50·75
68	18	Triform	100	52·6	51·6	50	46	47·4	48·4	50	54
223	61										

NOTE.—The numbers for the fixed gas and oil lights are at times higher than those for the same lights when revolving. This does not mean that the fixed were better than the revolving lights, but that the standard electric fixed light was not so superior to the fixed gas and oil lights.

The relative power of electricity, gas, and oil in weather not clear, at great distances, is admirably described in the same report.

It appears that at distances under 5 miles, quadriform gas and triform oil were better than biform electric. As the distances were increased the electric light seems to have come to the front. The permanent electric lights are reported as showing up well, although the experimental electric light was so much impaired at the short ranges.

Again on December 6th, 1884, in a fog and drizzling rain, we find that the observations unanimously indicate that triform electric is little if at all better than quadriform gas or triform oil, and that the single electric arc with three machines is much superior to the triform arrangement.

On February 16th, 1885, in a dense fog and very heavy rain, the summary of results by four observers is given as greatly in favour of the single electric light with double current, but although its candle force is so superior to gas and oil, yet we find that its superiority over both is only a distance of 200 feet, not a steamer's length!

Mr. H. B. Dixon's Photometric Experiments.

These were so important and thorough that I venture to quote from his report on the determination of the total light of each illuminant, electricity, gas, or oil, but the general result may be roughly stated as showing but little difference between oil and gas.

The only object of these notes is to demonstrate the advantage of an economical system of gas over oil in saving expense of first cost and maintenance.

Mr. Dixon says the illuminants submitted to trial were:—

A. The De Meritens electric light, with one, two, and three magneto-electro machines.

The carbons used were "solid," "core," and "bundle" carbons.

B. The Wigham gas burners with 28, 48, 68, 88, and 108 jets.

The Douglass argand gas burners with 10 rings and with 6 rings.

The Sugg argand burner with 6 rings.

The Siemens regenerative burners, large and small.

The gas used was cannel gas of 20 to 30 candle-power, and oil gas of 40 to 45 candle-power, per 5 cubic feet.

C. The Douglass oil burners with 6 wicks and with 7 wicks.

The Service oil burner with 4 wicks was also tested for the purpose of comparing it with the other illuminants.

A. *The Electric Light.*

The electric light was tested with the bar-photometer at a distance of 220 feet. Ten readings were made alternately by Mr. Vernon Harcourt and myself. In making the reading no attempt was made to measure the sudden intense flashes of a second or two duration, or the equally brief extinctions of light which occur from time to time with the electric arc. Each reading represents as nearly as may be the average light over a period of 20 or 30 seconds; the mean of the 10 readings gives the average light over a period of four or five minutes.

1 Machine. 40 mm. Solid Carbons.

Results.

1.	8,430	candles.	H. B. Dixon.
2.	9,200	„	A. Vernon Harcourt.
3.	8,880	„	H. B. Dixon.
4.	8,880	„	A. Vernon Harcourt.
	8,850	Mean.	

1 Machine. 30 mm. Core Carbons.

Results.

1.	9,890	candles.	H. B. Dixon.
2.	10,770	„	A. Vernon Harcourt.
3.	11,640	„	H. B. Dixon.
4.	11,190	„	A. Vernon Harcourt.
	10,870	Mean.	

2 Machines. 40 mm. Solid Carbons.

Results.

1.	14,530	candles.	H. B. Dixon.
2.	10,660	„	A. Vernon Harcourt.
3.	12,510	„	H. B. Dixon.
4.	13,320	„	J. Sparling.
5.	13,040	„	H. B. Dixon.
	12,830	Mean.	

2 Machines in quantity. 81 Bundle Carbons.

Results.

1.	11,420	candles.	H. B. Dixon.
2.	18,870	„	A. Vernon Harcourt.
3.	18,630	„	H. B. Dixon.
	16,310	Mean.	

2 Machines in series. 81 Bundle Carbons.

Results.

1.	13,900	candles.	H. B. Dixon.
2.	13,600	„	J. Sparling.
3.	12,500	„	A. Vernon Harcourt.
	13,330	Mean.	

These results show that in the photometric gallery two machines do not give double the light of one machine in the electric arc. The

"core" carbons gave a better result than the "solid" carbons. Afterwards core carbons of 40 mm. diameter were obtained, and were used in A tower.

B. *Gas Burners.*

The Wigham Gas Burner.

The Wigham 108-jet burner was tested with different consumptions of cannel gas with the following results. Each result is given by the mean of ten observations with the bar and with the table photometer.

No.	Illuminating power in candles.	Corrected rate of consumption of gas.	Value of gas.	Duty. Illuminating power per cubic foot of 24 candle gas.
1	2,249	295·3	27·6	6·62
2	2,252	302·0	24·9	7·20
3	2,295	312·4	25·7	6·86
4	2,331	319·5	26·06	6·73
5	2,433	351·4	25·7	6·47
6	2,425	368·2	25·7	6·15
7	1,683	214·8	41·6 (oil gas)	4·52

The highest illuminating power was given with a consumption of 350 feet, the highest duty with a consumption of 300 feet per hour. The burner did not consume oil gas to the same advantage as cannel gas.

The smaller sizes of the Wigham burner were tested with the following results:—

Burner.	Illuminating power.	Corrected rate.	Value of gas.	Duty.
88 jets	1,400	246	25·4	5·38
68 "	992	160	25·8	5·77
68 "	822	150·8	21·8	6·03
48 "	677	112	26·0	5·56
48 "	572	109·7	22·0	5·69
28 "	249	45·2	26·7	5·05

2. *The Douglass, Sugg, and Siemens Gas Burners.*

The Douglass 10-ring argand burner was tested with different consumptions of cannel gas in the same way as the Wigham 108-jet burner:—

No.	Illuminating power.	Corrected rate.	Value of gas.	Duty.
1	2,323	197·3	27·6	10·20
2	2,594	231·6	27·6	9·73
3	2,619	271	25·7	9·02
4	1,915	136	41·6 (oil gas)	8·12

The illuminating power increases as the rate of consumption is raised from 200 to 270 feet, but the duty is greatest with a consumption of about 200 feet.

The other gas burners were tested with the following results:—

Burner.	Illuminating power.	Corrected rate.	Value of gas.	Duty.
6-ring Douglass ..	825	101·2	27·6	7·02
" " ..	853	72·8	41·4 (oil gas)	6·79
6-ring Sugg......	824	195	22·0	4·61
Large Siemens ..	600	90·1	22·0	7·27
Small Siemens ...	194	39·0	22·0	5·39

The 6-ring Douglass burner gave the best light with a consumption of 100 feet an hour, with oil gas its illuminating power was increased, and its duty but slightly diminished. The Sugg burner evolved large quantities of smoke, which made it impossible to burn it in the lighthouse lantern at its full power. As the smaller Siemens burner gave too little light to be useful in a lighthouse, it was not tried in the experimental tower.

C. *The Douglass Oil Burners.*

The 7-wick and 6-wick oil burners were tested in a similar manner to the gas burners. The 6-wick burner gave a very constant light, the 7-wick showed greater variations.

Burner.	Mean illuminating power.	Mean consumption of oil per hour.	"Duty" light per gallon per hour.
7-wick..............	947	1 gallon	947
6-wick..............	730	0·625 "	1,168

Similar tests were also made of the larger Douglass burners, and of two smaller burners in the lighthouse service. Although these

burners were not entered for competition, a comparison of their illuminating power with that of the 7- and of the 6-wick may be of interest.

Burner.	Illuminating power.
9-wick	1,785 candles.
8-wick	1,400 „
7-wick	947 „
6-wick	730 „
5-wick	620 „
4-wick	415 „

Taking the average of the measurements made on the clearest nights, the intensity of the beam of each illuminant as a revolving light is given in the following table:—

	Eddystone lens.	Mew Island lens.	Cylindrical belt and vertical prisms.
Gas.	Pyres.	Pyres.	Pyres.
Douglass, 10-ring	105	94	
„ 6 „	92	70	
Wigham, 108-jet	..	59	
„ 88 „	..	54	
„ 68 „	..	48	
„ 48 „	..	42	
„ 28 „	..	33	
Sugg, 6-ring	55?		
Siemens (large)	10*		
Oil.			
Douglass, 7-wick	60	49	
„ 6 „	64	48	
Service, 4-wick	55	44	
Electric.			
1 machine	..	..	1,250
2 machines	..	..	1,500

* This is the illuminating power at the centre of the beam. Owing to the construction of the burner, the edges are much brighter than the centre, so that the cone of light thrown by the annular lens is much brighter at its edges than in the middle. As the lens revolves the observer sees two flashes of bright light, with a dull light between.

These values divided by the previously determined illuminating power of each unaided lamp give the lens-factors for each illuminant:—

TABLE B.

Burner.	Illuminating power of naked light.	Illuminating power through lens in clear atmosphere.			Factor of lens.		
		Cylindrical belt and vertical prisms.	Eddystone lens.	Mew Island lens.	V.P.	Ed.	M.I.
Electric, 1 machine	10,000	1,250,000	..	..	125		
,, 2 ,,	15,000	1,500,000	..	..	100		
Douglass, 10-ring, gas	2,500	..	105,000	94,000	..	42·0	37·6
,, 6 ,, ,,	825	..	92,000	70,000	..	111·5	84·8
Wigham, 108-jet, gas	2,300	..	..	59,000	..	..	25·7
,, 88 ,,	1,400	..	..	54,000	..	..	38·6
,, 68 ,,	990	..	..	48,000	..	..	48·5
,, 48 ,,	680	..	..	42,000	..	..	61·8
,, [28 ,,	250	..	..	33,000	..	..	132·0
Sugg, 6-ring, gas	820	..	55,000	..	..	67·1	
Siemens, gas	600	..	10,000	..	..	16·7	
Douglass, 7-wick, oil	950	..	60,000	49,000	..	63·2	51·6
,, 6 ,,	730	..	64,000	48,000	..	87·7	65·8
Service, 4 ,,	415	..	55,000	44,000	..	132·5	106·0

Shown through annular lenses the smaller flames are far more economical of light than the larger, the larger flames, however, have the advantage of throwing a broader beam and so producing a longer flash than the smaller. But the larger flames have a distinct advantage over the smaller in thick weather, for the light from the large burners is less cut down by haze and mist than the light from the smaller burners.

It is not intended to follow this highly interesting report further in quoting from its detailed statements, but only to add a summary of some of the conclusions arrived at in regard to gas, which seem to be—

First. That for a revolving light, the large flame of gas has a distinct advantage over the small flame of oil as respects the duration of flash.

Second. That gas offers peculiar advantages for producing short flashes by sudden extinction and re-ignition, and also for producing atmospheric thrills, which are of great value in a fog.

Third. That the general result of sky-flashing is not favourable to its adoption.

Fourth. That light for light there is no practical difference between gas and oil flames, seen through the annular lenses of a revolving light, but that four superposed gas lights are a little better than three 6-wick mineral oil burners.

Fifth. That the heat of the Wigham burners in quadriform is a serious objection to this system.

Sixth. That for lighthouse illumination with gas the Douglass patent gas burners are much more efficient and economical than the Wigham gas burners.

Seventh. That the electric light is absorbed more largely by haze and fog than either the gas light or oil light.

The complete inutility of even the strongest lights in thick weather cannot but suggest to the thoughtful inquirer, whether it would not be safer to protect dangerous outlying reefs, shoals, and low coasts by a system of gas-lit buoys burning day and night, with a light 15 feet above the sea, visible in clear weather from 6 to 10 miles, and in a fog distinguishable several hundred feet.

That such lights exist, and can burn continuously from six months to one year, we have abundant evidence in the official reports of the first authorities in the United States on the Foster gas-beacons and buoys, and in the award at the International Fisheries Exhibition, London, 1883, of the highest premium, a gold medal, to the Foster gas-buoys.

There are many parts of the British Empire where navigation is difficult and dangerous, and where light-vessels have been carried away on account of the large surface they offer to the wind and waves.

Intricate channels, usually impossible of navigation by night, could be easily marked by gas-lit buoys painted of distinctive colours, and made visible by reflected light masked by a screen, which would be beneath the buoy-light proper. Such dangerous navigation as the

mouth of the Hooghly River and the passage through its tortuous channels to Calcutta, Bombay Harbour, the Island of Ceylon, the Irrawaddy, and other great rivers, might be rendered safe and navigable on all nights by a judiciously studied system of gas-lit buoys.

Many unprotected islands, shoals, and coral-reefs—the cause of so many wrecks, as the recent loss of the P. and O.'s fine steamer "Indus," and a more recent wreck of an English steamer in the Straits of Bab-el-Mandeb, are but a few examples in a thousand—might be distinctly marked, and the small cost of installation and subsequent maintenance would be but a fractional part of the losses occurring to merchants, shippers, and insurance companies from the wrecks, but now too unfortunately frequent. Lloyd's list of wrecks shows an average of about a hundred a day in all parts of the world, a great proportion of which occur at night, or from uncertainty of position, when a well-devised system of self-sustaining lights would prevent many of such disasters.

The Italian Government, which in marine affairs is now certainly one of the Great Powers of Europe, has shown its appreciation of a system of gas-lit buoys by ordering two of Pintsch's buoys for trial at the entrance to Naples, and by also decreeing an experiment with Foster's system at Genoa in the coming spring, after which it is their intention to place a quantity of buoys in the Red Sea to mark the difficult navigation on approaching Massowah, eventually destined to become a great centre of commerce, as the port of export from Abyssinia and Central Africa.

All Governments are notoriously slow in dealing with new inventions, but the favourable results shown in the United States by the Foster buoys and beacons, and the many awards of competent juries, place this system on an exceptional footing.

I wish it distinctly understood that I do not claim for Mr. Foster the first idea of filling buoys with gas, for as far as most careful investigation of the records show no one prior to Mr. Julius Pintsch, of Berlin, in 1876, ever suggested gas-lit floating lights.

The Trinity House Board have used Pintsch's gas-buoys for some years, but intend experimenting with Foster's buoy, which is entirely novel in construction and contains gas compressed to 40 or 50 atmospheres, while eight is the pressure of Pintsch's buoys.

While convinced of the great advantage to be obtained by a judicious and extended use of gas-buoys, there is still a large field for improved light-towers made of tubes containing compressed gas—thus serving a twofold purpose—to mark headlands and shallow waters, in many parts of the British Empire, and in savage countries where a staff of attendants is impossible, or where, as sometimes occurs on desert islands and the coasts of Africa, there is neither food nor water to be obtained. The respect and awe of savages for a light burning day and night with no visible source of supply, would ensure the safety of such a light in countries where the establishment of a light-station might be dangerous.

There is no limit to the size of these light-towers, and their term of

service when charged could be arranged from one month to one year without refilling, according to strength of light required.

Useful lights giving 200 candle-power naked light or 1,000 candles with optical apparatus, visible 15 to 20 miles in clear weather and consuming $6\frac{1}{4}$ feet an hour, with occultations of 15 seconds each minute, would burn from 10 months to a year.

The manner of supplying detached lighthouses and gas-buoys by a tender on which the gas may be generated and compressed into the reservoirs, is shown by the illustration on the wall.

The device of a bent gas-tube to supplant rubber hose, which burst under the great pressure adopted in the Foster system, is due to Mr. Scott, an assistant light-keeper in Currituck Sound, North Carolina, where ten beacons have been in service since 1880.

With these preliminary remarks as to the utility of the system of compressed gas, I now propose describing in detail certain portions of Foster's Compressed Gas as applied to beacon lights, signals, and buoys.

Rapid advances in the arts and sciences have led to numerous valuable improvements in nearly all branches of industry, but none are more important in their peculiar province than the use of gas for lighting beacons and buoys as applied to the system described in this paper. Practical demonstration has proved that the advantages attending the use of this luminant in preference to oil are as marked when adapted to the lighthouse service as in domestic use, and when to this superiority is added wonderful economy in cost of maintenance, and far greater reliability under trying circumstances, further argument in favour of its general adoption seems unnecessary, though a comprehensive summary of cause and effect is not out of place in this connection, in order that a thoroughly intelligent understanding may be reached.

To render the use of gas available for this purpose it is necessary to compress an immense volume of the fluid into the smallest possible space and to provide a receptacle for its storage, with sufficient capacity to supply a light for an extended period capable of being readily refilled; that shall be as nearly indestructible as possible, and when once charged, the arrangements for its consumption so perfect as to render the light reliable, and independent of supervision until the gas is exhausted.

The economy obtained by petroleum gas over petroleum oil may be demonstrated from Mr. Wooten's report, as General Manager of the Reading Railroad, to the Directors, by which we learn that the saving effected in about two years was sufficient to cover the whole outlay expended on the outfit, a sum of 5,097*l.* sterling. This too in a country abounding in petroleum. The saving of labour in cleaning and trimming the lamps is also a not inconsiderable item when on a large scale.

The distinguishing merits of the Foster system are:—

First.—In an apparatus producing from a most available, plenteous, and low-priced material, a perfectly "fixed gas" of intense illuminating power, which deteriorates neither when subjected to low temperatures nor any degree of compression.

This is of the greatest importance in using compressed gas in the lighthouse service, for the volume which must be stored is in minor proportion to the illuminating power of the gas; 1,000 cubic feet of this gas will give as much light as 200 lbs. of sperm candles, about five times as intense as coal-gas.

Second.—In a compressor equally free from complication and so throughly effective, that 3,500 lbs. to the square inch has been attained by it; in this particular lies one of the most prominent merits of the Foster system; for it will be apparent that the advantages to be derived from the use of compressed gas will be increased with the degree of pressure, and the consequent reduction of volume.

This is specially true of the use of compressed gas for lighting beacons and buoys, when the principal object to be attained is to put the largest quantity into the smallest space, in order to reduce the size and cost of storage tank to a point admitting the use of gas pipes or tubes for receptacles, instead of reservoirs made of large plates, riveted or welded together, which are liable to injury from any violent contact, are costly to repair even when it is possible so to do, and with which there is no assurance that they will not become useless at a time when their absence or condition would be fatal to the interests or lives for which they are supposed to afford protection.

The Third prominent feature of the Foster system is the automatic appliance for regulating the flow of gas to the burner, without which the enormous pressure operated by this system would be valueless.

When it is understood that the pressure per square inch in a tank containing forty atmospheres of gas is equal to a column of water about 16,000 inches in height, and that the pressure of gas at the point of consumption should be equal to a column of water seven-tenths of an inch, while the gas in the supply tank is being consumed and the pressure diminished down to the last inch, it will be understood how important is the office of the governor.

This invention, the result of many years of study and costly experiment, is the only *perfect* appliance of the kind yet devised.

The cheapest, safest, and best system of lighting is with petroleum-gas. Its production costs less than coal-gas, is much more luminous, and when properly made, is susceptible to great compression, without material deterioration. The expense of manufacturing gas under the Foster system is equal (lighting power considered) to about one-tenth the average selling price of coal-gas, and in estimating the probable saving by its use it is safe to calculate on this basis. The cost of lighting by this system, as compared with high test mineral oil, is about 40 per cent. less.

Complete works for manufacturing and compressing the gas cost from 1,000*l.* to 3,000*l.*, according to capacity and local conditions. The principal object of compressing gas is to contract its volume to the smallest possible space, in order to carry a long period of supply in receptacles of convenient size, hence it will be apparent that the advantages to be derived from any compressed gas system will be increased in proportion to the degree of pressure operated, and the consequent reduction in volume; in other words, *that system is the best*

TABLE C.—*Comparative Cost of Luminants.*

Order of light.	Candle-power U.S. Light-house Standard.	Consumption of oil per annum.		Consumption of gas per annum.		Comparative cost of luminants per annum.				Percentage increase in cost of oil over the Foster system.
		Mineral oil. Gallons.	Lard oil. Gallons.	Coal gas 14 candle-power. Cubic feet.	Petroleum gas (Foster system). Cubic feet.	Mineral oil at 18 cents per gallon.	Lard oil at 90 cents per gallon.	Coal gas at $2·00 per thousand feet.	Petroleum gas (Foster system) at $1·00 per thousand feet.	
First	400	..	938	625,968	125,193	..	$844 20	$1,251 93	$125 19	574 per cent.
Second......	164	..	560	255,762	51,152	..	504 00	511 52	51 15	885 „
Third	78	270	..	120,312	24,062	$48 60	..	240 62	24 06	100 „
Fourth	32	137	..	50,000	10,000	24 66	..	100 00	10 00	146 „
Fifth	18	86	..	27,955	5,590	15 44	..	55 91	5 60	175 „
Sixth	12·5	40	..	18,765	3,753	7 20	..	37 53	3 75	92 „
Light-vessel .	18 to each lamp	16 lamps 1,088	..	not practicable	89,120	195 84	..	..	89 12	117 „
Buoys	10·5*	..	..	not practicable	7,324	..	..	..	7 32	

* The buoy light may be increased to the intensity of 50 candles, when necessary.

which produces an equal light for the longest period from a given sized cylinder.

The Foster system as satisfactorily operates forty atmospheres of pressure as others do eight atmospheres, reducing the gas cylinder to one-fifth the size; or, with the same cylinder capacity, giving an equal light five times as long as any other; this is accomplished to such an extent by the Foster apparatus, that receptacles holding the gas under pressure are made of lap-welded tubes, 15 inches in diameter, having heads welded in each end, instead of being made of large plates rivetted together, which, besides being unreliable, are heavy, cumbersome, and expensive.

The cost of operating the Foster system as shown by the foregoing table, is based upon the standard intensity of light and number of hours of service adopted by the United States Lighthouse Department in burning oil, which in all cases necessitates the employment of keepers. The large saving shown is but a small percentage of the actual reduction in cost of maintenance under this system. At stations operating fog-signals and revolving machinery where keepers are absolutely required, the force can be largely decreased. Proper attention to oil lights involves the cleansing of lamps and chimneys, trimming wicks, care and measurement of oil, lighting and adjustment of flame, and almost constant watching while lighted.

The operation of the compressed gas system involves no more care than a simple gas burner in a private house. The governor once regulated, only the required gas can pass to the burner, insuring an unvarying flame until the supply is cut off or exhausted. Fixed lights of the fourth, fifth, and sixth order, having no machinery, or where it is possible to introduce our automatic appliances, and which are accessible by a tender, require no keeper under the Foster system, and the saving thus effected would, in many instances, repay the entire cost of apparatus in from one to two years.

Under such circumstances the lights necessarily have to burn continuously (as is the case with our beacons in Currituck Sound), and an increased consumption of gas results, costing as follows:—

For a fourth	order light,	about	£4 12*s*.	per annum.
„ fifth	„	„	£2 13*s*.	„
„ sixth	„	„	£1 17*s*.	„

Where gas is to be supplied to buoys, or to lights placed on permanent structures, it is advisable and most economical to place the generating and compressing apparatus on a "tender," specially designed for the purpose, and as it would only be necessary for the "gas tender" to visit the stations once in six or twelve months, according as provision is made, it would be capable of supplying hundreds of lights. Oil and fuel for one round trip to all the lights could be taken on board at points affording the cheapest market. Proper provision for the storage of oil in suitable tanks instead of in barrels reduces its cost, and by this means the "gas tender" could supply stationary works located at buoy depôts with petroleum.

By this system, compression of the gas may follow immediately

upon its generation, and in such case it is forced at once into the storage tanks provided, the entire proceeding being carried on, regardless of the vessel being at rest or in motion. From ten minutes to one hour, dependent upon the capacity of the beacon-tanks or buoys, would be expended in charging, and if the lights were not very close together, sufficient gas would be generated in the intervals between stoppages at stations to immediately supply the receptacle when reached.

An infrequent visit, possibly not oftener than once in three or six months, to cleanse the lens, which can be done by a resident of the neighbourhood or by a passing tender, will be all the attention required under this system, after the reservoirs have been charged for a stated period, six or twelve months. The absolute necessity for the increase of lights and signals on our waters is well understood, and forcibly illustrated by the almost daily records of destruction to life and property in connection with transportation by vessels, and the intelligence of the age insists upon the adoption of the most perfect, reliable, and economical appliances to the attainment of this result.

Detailed Description of the Foster Apparatus.

The Gas Works.

The cheapness of petroleum and the ease with which it can be vaporized, or converted into a gaseous form, have led to many attempts to use it for the production of illuminating gas. Although some measure of success has attended even the rudest efforts of this kind, yet the great difficulty has been to produce a *fixed gas*, or one which would not smoke nor condense and thus deposit tar and other obstructions in the apparatus used, nor lose its luminosity when subjected to low temperature or great compression, and at the same time keep the latter so simple that a person of ordinary intelligence could manage it.

To those who are not familiar with the process of converting petroleum into gas it may be said that if in the process of conversion too low a degree of heat be used, some portions of the gas produced will be readily condensed, and the gas thus lose its luminosity and form a deposit of coal-tar and other substances in the apparatus. In other words, a certain high degree of heat must be employed to make the gas non-condensible under the ordinary circumstances of its use. On the other hand, if the temperature be too high, the carbon in the petroleum will be deposited in the retorts in a solid form, thus leading speedily to their destruction. Success in the production of petroleum gas is therefore dependent on the regulation of the temperature during the process of gasification. This is difficult to do, for the reason that if liquid petroleum be injected into a hot retort and converted into gas it will absorb an enormous amount of heat in the process of changing from the liquid to a gaseous state. This principle is illustrated in the boiling of water. Under atmospheric pressure water boils at 212°, and the temperature of steam at the same pres-

sure is also 212°. It is, therefore, often thought that to convert water into steam under those conditions all that is required is to heat it to that temperature. But when this has been done we have simply water boiling hot. To convert it into steam we must continue to add more heat, which in the old phraseology was said to become "latent." The *quantity* of heat contained in a pound of boiling water is 212 units, whereas a pound of steam of atmospheric pressure has 1,178·1 units. In other words, the amount of heat required to convert a pound of boiling water into steam is $1,178 \cdot 1 - 212 = 966 \cdot 1$ units, which has been called "the heat of gasification." The conversion of petroleum, or any other substance, into gas, is attended with exactly similar phenomena, that is, an enormous amount of heat is absorbed in gasifying it. To maintain the requisite temperature in the retorts, therefore, they must be heated very hot, which either produces a deposit of solid carbon in the inside, thus impairing their efficiency, or they are rapidly destroyed by the great heat. On the other hand, as already explained, if the retorts be not kept hot enough the product will not be a fixed gas, but will condense and deposit tar in the apparatus.

In this dilemma the resort has usually been to the use of retorts at so low a heat as to be incapable of making a fixed gas, and to use a quantity of air or non-luminous gas to carry the imperfect products to the place of consumption—a practice resulting in great waste, and, although the effect of a very small quantity of air in very rich gas may not be noticed, the admixture of large quantities rapidly destroys the lighting power. So great is this destruction that 1,000 feet of oil-gas which is capable of giving as much light as 200 lbs. of sperm candles, when mixed with 1,000 feet of air, forming 2,000 feet of so-called "mixed gas," will give only as much light as 100 lbs. of sperm. This is of great importance if gas must be compressed and stored in a portable holder, as it must be for beacons and buoys, for the volume which must be stored is in inverse proportion to the illuminating power of the gas.

In the manufacture of petroleum gas, then, the temperature should be regulated so that it will not be high enough to destroy the retorts rapidly, or cause the carbon in them to solidify, and yet the heat should be sufficient to produce a fixed gas with a high illuminating power.

While this process is not confined in its use to the manufacture of gas for illuminating beacons and buoys alone, yet it has the advantage of producing gas of higher illuminating power which does not lose luminosity when compressed, and which will not deposit any tarry or liquid substances in the process of manufacture.

The Foster Compound Gas Compressor.

Two great difficulties attend the compression of gas or air, especially under a high pressure. These are :—

First. The development of "latent" into sensible heat, which necessarily results from compression. In other words, the tempe-

rature of gas is elevated by compressing it, consequently there is a diminution of volume when the fluid afterwards becomes cool.

Second. The loss of effect following an imperfect displacement of all the gas from the pump cylinder at each stroke, which results in a re-expansion of the gas left in the cylinder, thus partly filling it with gas that has once been compressed instead of taking a cylinder full of *fresh* gas at each upward stroke of the piston. Various attempts have been made to overcome these difficulties, but with only partial success, so that generally it has been concluded that it is better to use comparatively low pressure than to encounter the difficulties referred to.

In order to be able to attain a high degree of compression, Mr. Foster has adopted what is known as the compound principle in the gas compressor. The result is so successful that 3,500 lbs. pressure to the square inch has been obtained, as has been previously stated in this paper.

The Foster Gas-lighted Buoys.

The Foster buoy is composed of a group of 7 or 13 lap-welded cylinders, made without seams or rivets, each cylinder forming in itself an independent water-tight compartment, capable of withstanding heavy concussion from floating bodies such as would prove fatal to those constructed of the large plates now used in other gas-buoys. These cylinders, like those employed in our beacons, are capable of being charged with gas compressed to from 40 to 50 atmospheres, and the supply is sufficient for six or twelve months, according to size and number of gas cylinders. Its subdivision of receptacles gives assurance of buoyancy, even should one or more cylinders receive injury of a character which would cause inevitable loss, by sinking, of any other buoy having but one or two compartments. Each cylinder having an independent check-valve prevents the escape of gas from the other tanks, should any of them be injured.

To practically exhibit the workings of the Foster buoy, one of the structures was on July 1st, 1882, placed in the Delaware River, where it remained burning continuously until October 1st, when, by authority of the United States Lighthouse Board, it was moored near the Fourteen Foot Bank Light Vessel, in Delaware Bay, a most exposed position, and it there remained until November 15th, 1882, when the gas became exhausted. Another experimental buoy was carried down the Delaware River from its moorings in a strong flood, and after a period of several days was found aground in Delaware Bay, with its light still burning, notwithstanding the shocks and knocking about it had received.

The Foster Gas Lighters Beacon and Automatic Fog Signal and Flash Light.

The beacons were first adopted by the United States Lighthouse Department in the latter part of 1880, when ten were erected for lighting the waters of Currituck Sound, N.C. and Va.

Since their introduction numerous and valuable improvements have been made by the patentee, the most novel of which is an automatic fog bell and flash light attachment. The power for operating the machinery is furnished by the rise and fall of the tide acting upon a float inclosed within a water-tight caisson, to which water is admitted in given quantities, and provision is made for the continued operation of the apparatus during "slack water," except for a period of a few minutes.

In this device the light flashes simultaneously with each stroke of the bell, thus enabling the navigator to determine his exact position by timing the interval between the flash and sound signals.

This structure is particularly adapted for marking shoal and dangerous places, and entrances to harbours and rivers, and will operate successfully when there is a rise and fall of 5 feet or over; it may also be erected on shore when pipe connection with low water is admissible.

The Use of Compressed Gas in Naval Warfare for Torpedo and Submarine Boats.

Gas made from petroleum is capable of great compression, and with Foster's compressor as much as 3,500 lbs. to the square inch have been obtained (about 230 atmospheres).

Compressed hydrocarbon can be contained in a very small space for the service it performs. There is absolutely no waste attached to its use. Under proper regulation entire combustion takes place, and consequently there is an absence from smoke, so serious a drawback to all coal-fuel.

With coal we have besides 90 per cent. of loss in solid substance, which is utterly useless, occupies valuable space, and subsequently has to be thrown overboard, entailing much time and labour.

By means of the steam generators which I employ I am enabled to obtain a high efficiency with small boilers or apparatus.

So quickly is water converted into steam that the boilers can make 200 lbs. of steam pressure, while only containing a few gallons of water at a time, therefore even if a coil burst, the damage would be slight.

The water is heated in stages by being split up into thin streams by passing it through spiral or helical coils of pipes, themselves constituting a boiler, or in combination with an annular boiler, formed by placing one dome-shaped shell within another, that would by itself constitute a boiler. Heat is applied by the use of compressed gas passing through atmospheric or other burners, so arranged that the greatest amount of heat may be generated by the combustion of the gas either with air or oxygen, and transmitted in the most efficient manner to the pipes through which water or steam is flowing.

The products of combustion are then collected, and either escape in the usual way or are forced by pressure through an escape valve, combustion in some cases taking place under the influence of a compressed atmosphere.

The advantages I claim for gas over any other substance are its freedom from smoke when properly regulated, its instantaneous ignition and equally instantaneous extinction, its perfect combustion, facility of manufacture, and satisfactory service.

The requisites for torpedo-boats, and especially submarine boats, to render them efficient are great speed, compactness, quick manœuvring, and certainty of action. All machinery is liable to fail, and the power which supplies machinery may equally become exhausted at a critical moment. In any submarine boats when coal is used a certain period must elapse after ignition of the fires has occurred before they can be in full service. With gas we get up steam in a few seconds, either below or above water.

The little American boat "Stiletto," that made 29 miles in 1 hour and 17 minutes, on a gallon of water in a beehive coil boiler, is an example of this principle.

Petroleum is stored in tanks, and can be made much more effective than coal, as its bulk is not wasted. These tanks should be on the supply tender.

I should propose that when a fleet of submarine boats were employed, a tender provided with gas generating apparatus and compressor be used to supply compressed gas to the torpedo-boats. But as this service would probably be more particularly confined to the protection of harbours and estuaries, provision for gas stations is easily made.

An idea has lately been protected for raising steam by the aid of Foster's compressed gas as fuel, with a view of substituting it in the place of coal, more especially when storage dimensions are limited, and when the area of boiler space has to be reduced to a minimum, and it is at present under consideration whether this system may not be advantageously adopted as a motive power for the propulsion of submarine boats. Its primary recommendation is that we can stow sufficient compressed gas in such a vessel capable of providing fuel for a much longer period than will be necessary to remain in action.

Secondly, its storage being of course in sealed cylinders, it is a matter worth consideration that these cylinders can be placed within the space reserved for the reception of water required for sinking purposes, allowing of course for a certain amount of increased space being required in that compartment due to the area of the gas tubes, so that by raising the deck over the water space a few inches, a clear way from fore to aft will be secured for the reception of whatever machinery may be called into requirement.

As of course boiler space is a matter of serious moment in these vessels, it is necessary to provide those which shall have the greatest amount of heating surface combined with the most effective circulating powers, and I am of opinion that a boiler constructed almost entirely of spiral tubes, as previously described, through which water would be caused to circulate freely, owing to the rapidity with which the small quantity of water in the boiler at one time would be raised to steam by the use of suitable burners through which compressed gas

Since their introduction numerous and valuable improvements have been made by the patentee, the most novel of which is an automatic fog bell and flash light attachment. The power for operating the machinery is furnished by the rise and fall of the tide acting upon a float inclosed within a water-tight caisson, to which water is admitted in given quantities, and provision is made for the continued operation of the apparatus during "slack water," except for a period of a few minutes.

In this device the light flashes simultaneously with each stroke of the bell, thus enabling the navigator to determine his exact position by timing the interval between the flash and sound signals.

This structure is particularly adapted for marking shoal and dangerous places, and entrances to harbours and rivers, and will operate successfully when there is a rise and fall of 5 feet or over; it may also be erected on shore when pipe connection with low water is admissible.

The Use of Compressed Gas in Naval Warfare for Torpedo and Submarine Boats.

Gas made from petroleum is capable of great compression, and with Foster's compressor as much as 3,500 lbs. to the square inch have been obtained (about 230 atmospheres).

Compressed hydrocarbon can be contained in a very small space for the service it performs. There is absolutely no waste attached to its use. Under proper regulation entire combustion takes place, and consequently there is an absence from smoke, so serious a drawback to all coal-fuel.

With coal we have besides 90 per cent. of loss in solid substance, which is utterly useless, occupies valuable space, and subsequently has to be thrown overboard, entailing much time and labour.

By means of the steam generators which I employ I am enabled to obtain a high efficiency with small boilers or apparatus.

So quickly is water converted into steam that the boilers can make 200 lbs. of steam pressure, while only containing a few gallons of water at a time, therefore even if a coil burst, the damage would be slight.

The water is heated in stages by being split up into thin streams by passing it through spiral or helical coils of pipes, themselves constituting a boiler, or in combination with an annular boiler, formed by placing one dome-shaped shell within another, that would by itself constitute a boiler. Heat is applied by the use of compressed gas passing through atmospheric or other burners, so arranged that the greatest amount of heat may be generated by the combustion of the gas either with air or oxygen, and transmitted in the most efficient manner to the pipes through which water or steam is flowing.

The products of combustion are then collected, and either escape in the usual way or are forced by pressure through an escape valve, combustion in some cases taking place under the influence of a compressed atmosphere.

The advantages I claim for gas over any other substance are its freedom from smoke when properly regulated, its instantaneous ignition and equally instantaneous extinction, its perfect combustion, facility of manufacture, and satisfactory service.

The requisites for torpedo-boats, and especially submarine boats, to render them efficient are great speed, compactness, quick manœuvring, and certainty of action. All machinery is liable to fail, and the power which supplies machinery may equally become exhausted at a critical moment. In any submarine boats when coal is used a certain period must elapse after ignition of the fires has occurred before they can be in full service. With gas we get up steam in a few seconds, either below or above water.

The little American boat "Stiletto," that made 29 miles in 1 hour and 17 minutes, on a gallon of water in a beehive coil boiler, is an example of this principle.

Petroleum is stored in tanks, and can be made much more effective than coal, as its bulk is not wasted. These tanks should be on the supply tender.

I should propose that when a fleet of submarine boats were employed, a tender provided with gas generating apparatus and compressor be used to supply compressed gas to the torpedo-boats. But as this service would probably be more particularly confined to the protection of harbours and estuaries, provision for gas stations is easily made.

An idea has lately been protected for raising steam by the aid of Foster's compressed gas as fuel, with a view of substituting it in the place of coal, more especially when storage dimensions are limited, and when the area of boiler space has to be reduced to a minimum, and it is at present under consideration whether this system may not be advantageously adopted as a motive power for the propulsion of submarine boats. Its primary recommendation is that we can stow sufficient compressed gas in such a vessel capable of providing fuel for a much longer period than will be necessary to remain in action.

Secondly, its storage being of course in sealed cylinders, it is a matter worth consideration that these cylinders can be placed within the space reserved for the reception of water required for sinking purposes, allowing of course for a certain amount of increased space being required in that compartment due to the area of the gas tubes, so that by raising the deck over the water space a few inches, a clear way from fore to aft will be secured for the reception of whatever machinery may be called into requirement.

As of course boiler space is a matter of serious moment in these vessels, it is necessary to provide those which shall have the greatest amount of heating surface combined with the most effective circulating powers, and I am of opinion that a boiler constructed almost entirely of spiral tubes, as previously described, through which water would be caused to circulate freely, owing to the rapidity with which the small quantity of water in the boiler at one time would be raised to steam by the use of suitable burners through which compressed gas

could be supplied at variable pressures, will be a preferable means for obtaining the motive power to that where coal firing is used.

Roughly speaking, without having the particulars of any experiments, and upon the supposition that gas is used from a storage compressed to 50 atmospheres, it is computed that steam will be raised to a sufficient pressure for propelling a boat not less than 60 feet long in a boiler, the dimensions of which shall not exceed 6 feet diameter at its base, and of a height not exceeding its diameter, and that fuel for seven hours firing could be carried in every 50 feet length of cylinders 15 inches in diameter.

We are all cognizant of the usefulness of steam as an agent to be relied upon, and I am strongly impressed with the idea that for purposes where there must not be a suspicion of possible failure, engine power is the only method worthy of consideration.

Colonel J. B. Richardson, R.A.: I should like to ask how the greater absorption of light is accounted for, whether light of one colour is more apt to be absorbed than light of another colour, whether experiments in different lights have been tried with reference to absorption. I should also like to ask whether these cylinders containing gas under very great pressure—a great number of atmospheres—could be used in the Red Sea as is suggested, or whether the great heat of the sun in that sea and in the tropics would not tend to burst them. We are told in the lecture that it has only been tried in New York, and that it is not capable of being damaged by cold. The question of the effects of heat has not apparently been taken into consideration.

Captain Curtis: I should like to make one remark with respect to the buoy that is exhibited. It is apparent to every seaman that where there are no highlands or high objects serving as landmarks in approaching a river, those buoys have great advantages over the ordinary kind. I should like to know if 45 atmospheres is the utmost limit to which the gas can be compressed, because I have an idea that it might be utilized on rivers in our pleasure yachts.

Mr. Rickman: Shall I be in order in asking if the lecturer is aware of a report made by Admiral Rowan, Chairman of the Lighthouse Board of the United States, to the Secretary of the Treasury, dated 16th February, 1883; and also whether he is aware of a report made by the Experimental Committee of the Lighthouse Board of the United States to Admiral Rowan, this report being dated April 23rd, 1884?

The Chairman: I would also like to ask Mr. Huntington to give us the cost of the gas so much per thousand feet.

Mr. Inglis (Secretary to the Trinity House, Tower Hill): I should like to make an observation or two upon this paper. The Trinity House, as you know, Mr. Chairman, are very much interested in anything approaching to an improvement in lighthouse work, and they will, I have no doubt, have very great pleasure in inquiring into the details of the scheme which Mr. Huntington has put before us. There are, of course, many questions to be asked with regard to the details of such a scheme, but it appears to me, in the first instance, that if he is hopeful of attaining such high powers as are mentioned in the Report of the Committee on Lighthouse Illuminants, he does not fully realize what quantities of gas he will require. Now we have here a 10-ring gas-burner consuming more than 200 feet per hour, and it is the work done by such a burner as that which is dealt with in the Report from which he is quoting. We have here again a 6-wick oil burner, of the type in common use in lighthouses round the coast, consuming paraffin or rape oil. To produce a light of that power we should need a very much more extensive system of supply for gas than is indicated in the paper; and it would be unsafe to assume that by the process described we should be able to secure lights of high power without the attendance of keepers. Nor could we supply them with compressed gas except at an expense enormously greater than that which we are called upon to meet in using oil or gas in the ordinary way. I think that the flame produced in

the burners of the Metropolitan Railway carriages, and which is spoken of rather slightingly in the course of the paper, is very much nearer the illuminating power that we shall have at our command by means of the compressed gas system, at all events for some time to come, such a light as we have in a lantern of this kind which is taken off the top of an actual gas-lighted buoy. Consequently, the quotation of those very large powers I think raises hopes that are not likely to be realized. The gas that we have used in gas-buoys at present is distilled from shale or mineral oil, and produces a high illuminating power, in fact with the Douglass burner it was made to beat the cannel gas at an experiment at South Foreland, that is to say, it gave a higher illuminating power in the same burner. Another question to be asked is whether the travelling and floating gas works spoken of have yet been brought into action. The lecturer speaks of making and compressing gas as you go along, and of putting it into buoys or landing it into beacons; but I should like to ask, has it yet practically been done? We find that a buoy, lying of course in more or less disturbed water according to the state of the weather, has to be filled with gas by attaching one end of a flexible pipe to the receiver on board the vessel, which receiver is charged with gas to about 20 atmospheres, and the other end to the buoy brought alongside. The gas, passing from the receiver through the tube, rushes into the buoy until the pressure in each is nearly equal, so that we get, perhaps, 10 atmospheres left in the receiver on deck, and 10 atmospheres in the buoy afloat. If the buoy is to be served afloat in this way, the anticipation that we shall be able to make our gas and to compress it direct into the buoy is rather sanguine. If we might hope always to lift the buoy on deck, the process would perhaps be easier; but serving it as we do now, I am afraid we shall not be able to get the pressure spoken of, and consequently shall not attain the long duration of unreplenished service which is anticipated for the buoy. As regards the floating structure shown in the drawing, I am not an engineer, and cannot speak with authority, but I am a little afraid that the mode of mooring will be found inconvenient, if not disastrous. We had an automatic buoy with a long tube reaching down far below it into the water, moored in that way in the first instance, and the chafing of the mooring round the part where it was attached was so great that the buoy got nearly waterlogged. In the absence of diagrams, of course we cannot see the process of making the gas. It would have been very instructive to have seen it; of course we shall learn more when the paper is published. One other remark I would make is that the buoy that is said to have come down the Delaware River in the ice without losing its light was a very fortunate buoy. I think it is probable that it was not so much knocked about as at first sight would appear, because one rather important difficulty we have had to overcome is the effect of a blow upon the buoy. A barge running against a buoy in the Thames, or even a boathook struck against it, has been known to put the light out; and that buoy at Sheerness was in the early stages of the experiment put out by the concussion occasioned by the firing of heavy guns. These are some of the questions, founded upon difficulties which have been overcome in the present state of the service in England, upon which some further information is desirable on the present occasion.

Admiral Brine: In the few remarks I propose to offer on this paper I shall confine myself almost entirely to the question of the automatic fog signal. The impression of most Officers who have been in fogs, or in any circumstances where it is important that they should know their position, has been that it is exceedingly difficult to realize where their position is by the sounds they hear, and I propose to ask the lecturer whether he will be able to inform us what experiments have been made in the United States with reference to two points: one, the best method of getting sound carried through a fog to indicate with reasonable accuracy the locality of such sound: and the second, the best method of carrying any illuminating power through a fog. Of course in lighthouses and in the various structures such as we see here illustrating this lecture there are certain things we can control. We can control the gas, or whatever may be the illuminant that is used; we can control the strength and height of the light, but what we cannot do is to be certain that in any given atmospherical conditions you are able to penetrate to the same distance with that light. I believe it has been ascertained by experiments undertaken by the Elder Brethren of the Trinity House that on days apparently precisely the same, and in

fine clear weather, light is extremely different as regards its power of penetration of the atmosphere. I believe in some cases the same light which on one clear night will be seen a certain given number of miles, on another night, apparently to the eye exactly similar, the light is only seen about one-half or one-third of the distance, and I am under the impression that no very clear explanation has been given as to the cause of this variation. As regards sound, the extraordinary fact occurs that at one time you will find that sound signals will travel and reach the ear at a distance not exceeding 3 miles, which is the ordinary reliable distance, and on other occasions the same sound will reach, I am told, as far as 15 or 16 miles under what appear to be precisely similar conditions. It has also been found that in fogs, in which it is generally supposed that sound does not travel well, it actually travels better than it does in fine or clear weather. It has also been ascertained that mist and snow are conditions of the atmosphere which are favourable for the conveyance of sound through the air. I would like the lecturer to tell us if he knows what experiments have been carried out in the United States upon the subject of sound signals. We know what has been done by our Trinity House within the last ten years, and the series of useful investigations that have been made with regard to this important subject.

Colonel Baylis: It has just been observed that the mere concussion of firing guns will extinguish the light. I think it was also said that a boat striking against a buoy, or even a boathook striking it, will put out the light. If that be so I should like to ask whether when a violent sea strikes against the buoy and vibrates it considerably, the light is or can be so protected as to ensure its remaining intact?

Mr. Huntington: A good many questions have been asked me which I am afraid I am unable to reply to, and some reports, which I have not even heard of, have been referred to in one question. I am first asked if there is anything in the colour of the light with reference to absorption. I think it has been understood that in gas and oil flames the red rays carry much further than any other rays, and that the violet tint in the electric light does not carry so far. With reference to the effect that the heat of the sun might have upon the compressed gas in situations such as the Red Sea, I may say that of course these tubes would be made of such strength as to resist any such extra pressure which might be brought to bear upon them. That is a matter which can be easily arranged. As I have said, I regret that I am not acquainted with the report made by Admiral Rowan in 1883, or the report made to him in 1884. Mr. Inglis has very kindly taken part in this discussion, and has asked some questions with regard to having the gas upon the tender. We have not at present had gasworks upon the tender itself, and the way in which the buoys have been supplied has been, as is suggested, that the reservoir has been put into a scow, and being connected with the buoy, the pressure was allowed to equalize. It is just as has been described, except that the pressure in the tanks was much higher than Mr. Inglis stated. The gas has never been generated in the vessel itself. It was only supposed that that would be a good idea for supplying a great number of lights on inland waters, where you have 50 or 100 lights to serve. It might not be required in this country.

Mr. Inglis: Do I understand you that you have 45 atmospheres in the beacon, or 45 atmospheres divided by 2?

Mr. Huntington: We get 45 atmospheres in the beacon. The pressure is much greater in the storage tanks, and it is equalized in the pressure. That is the report we had from the Lighthouse Department of the United States authorities. With regard to the buoy coming down the Delaware I may say I omitted the word "ice" in reading my lecture. The circumstance was told to me, but I am convinced that that statement must be incorrect. No doubt it was a strong flood, and the buoy was carried down in that flood, knocked about, and ran aground, but still the light did not go out. I have quotations from the daily papers speaking of the circumstance. I regret that I am not able to give the information that Admiral Brine asks for with regard to the effect of fog upon the transmission of sound. As to the cost of the gas, it would depend upon the price of petroleum. When petroleum is 4½ cents a gallon the gas would come to 19 cents a thousand feet, including everything. That is the cost in America—a little under 1*s*. a thousand feet. One man can make and compress 10,000 feet of gas in a day. I have seen it working myself, and have seen

one man do it, and I think that compares very favourably with the results obtained at any coal gasworks.

The CHAIRMAN : I am sure we are all very much indebted to Mr. Huntington for the able lecture which he has delivered on a very abstruse subject. Some parts of it were exceedingly deep. I know I felt that the tide had risen clean over my head. But there are some practical portions of this subject that one can grasp. Moreover, all these scientific matters have to bear the test of practical experiment, and of long-continued experiment. I speak mainly of the light he gets from the gas. The lighthouse authorities always experiment thoroughly upon any illuminant that may be proposed to be used for our lighthouses and lightships round the coast, in order that they may be able to rely upon the work which that illuminant can do. In this connection it may be interesting to gentlemen to examine these burners which are on the table. One is for oil with six concentric wicks. It is the burner which is in common use all round our coasts, and it produces a splendid light, so powerful that in clear weather we only use the three outer wicks. When the weather becomes misty we light up all six, and so we get a very powerful light. Then, we have this still more powerful gas-burner with ten concentric rings of gas. The six-wick oil-burner has been in common use for many years round our coasts. It shows a light equal to about 720 candles, and we can keep it going at an expenditure of half a gallon an hour, costing only about 3*d.* This is the consumption in foggy weather ; it is not above one-half or two-thirds of that in clear weather, when only half the wicks are burning. The oil is very easily conveyed to our lighthouses and lightships.

Admiral FREMANTLE : What sort of oil do you use?

The CHAIRMAN : Paraffin oil, distilled from Scotch shale. From a long-continued set of experiments which we have made at the South Foreland we find, as far as we can arrive at the cost, that we produce a light of 1,000 candles from paraffin oil (such as we use), and allowing for all expenses the cost would be about 10*d.* per 1,000 candles of light per hour. If we were to use gas produced from cannel coal it would cost us just double that, or 20*d.* an hour, and Mr. Pintsch's oil-gas comes to something between the two. I am sure that nothing under a series of exhaustive experiments will convince me that the gas which Mr. Huntington has told us of can be produced at such a very low figure as he supposes. If we add to its original cost the expense of conveying it to or making it at out-of-the-way stations where our lighthouses are placed, it would come to something very much higher, and I think very much beyond the cost of the oil which we now burn. Of course the oil produces ample light; quite as strong as is necessary. We have in one lighthouse two of these oil lamps, one above the other—the biform system. We light the second burner in foggy weather, and at a distance beyond a mile and a half it seems like one great light. There are other systems of lighting, with three or four lamps superposed, so that it is easy to produce as powerful a light as is at all necessary. I will not occupy your time any further; but I hope I may, in your names, thank Mr. Huntington for his very interesting lecture.

N.

Co
M
La
A
D
F
C

D
P
S
L
E
F
L

C
A

S
I
I
C
I
S

T

I
C
A

NAMES OF MEMBERS who joined the Institution between the 1st January and the 31st March, 1886.

LIFE MEMBERS.

Coats, T. G., Major 2nd Renf. R.V.
Monck, C. S. O., Lieut. Cold. Gds.
Lethbridge, W. P. C., Lieut. Gren. Gds.
Anstis, B. Du S., Lieut. R.N.R.
Dale, A. T., Capt. R.N.
Forbes, Wyndham, Mid. R.N.
Clark, W., Major 1st Bn. Oxf. L.I.
Bethell, Hon. A. E., Lieut. R.N.
Battenberg, H.S.H. Prince Louis A. of, K.C.B., Comr. R.N.
Dickson, J. B. B., Lt.-Col. 5th Drag. Gds.
Robertson, G. H., Esq., late 14th (P.W.O.) Regt.

ANNUAL SUBSCRIBERS.

Douglas, J. S., Lieut. R.A.
Pain, G. W. H., Lieut. Rl. W. Sur. Regt.
Saunders, A. J., Major late R.A.
Login, S. H. M., Lieut. R.N.
Baden-Powell, R. S. S., Capt. 13th Hus.
Beresford, M. de la P., Col. h.p.
Dundonald, Earl of, Lt.-Col. 2nd Life Gds.
Crofton, Duke A., Comr. R.N.
Arbuthnot, Sir Charles G., K.C.B., Maj.-Gen. late R.A.
Savile, C. C., Capt. 1st Glouc. A.V.
Feilden, G. C., Lieut. Seaf. Highrs.
Dauglish, G. V., Lieut. E. K. Regt.
Caunter, J. E., Lieut. the Welsh Regt.
Maxse, F. I., Lieut. Royal Fusiliers.
Scrivener, T. P., Col. late Q's. Westmr. Vols.
Timmis, I. A., Capt. 1st V.B. Q's. Rl. W. Sur. Regt.
Ridge, L. W., Major 20th Middx. R.V.
Douglas, J. D., Major R.A.
Quill, A. S., Col. ret.
Humphry, A. P., Lt.-Col. 2nd Camb. R.V.
Du Plat Taylor, St. J. L. H., Lieut. R.A.
Anderson, A. D., Major R.H.A.
Copland-Crawford, R. F., Gen. R.A.
McGrigor, C. R. R., Lieut. K.R. Rif. Corps.
Perry, C. S., Lt.-Col. Norf. Regt.
Keith-Falconer, C. E., Lieut. North'd. Fus.
Kennedy, W. C., Major A.P.D.
Featherstonhaugh, A., Major R.E.
Walter, W. F., Lieut. Lan. Fus.
Strickland-Constable, F. C., Capt. Rl. H. Gds.
Hemphill, F. B. R., Capt. Royal Berks Regt.
Johnstone-Douglas, C. F., Capt. 6th Drags.
White, A. W., Major R.A.
Macready, C. F. N., Lieut. Gord. Highrs.
Ridgway, T. A., Lieut. 3rd Middx. Arty. Vols.
Cunyngham, W. H. D., V.C., Gordon Highlanders.

OCCASIONAL PAPER.

This portion of the Number is reserved for Articles, either Original or Compiled, on Professional Subjects connected with Foreign Naval and Military matters; also for Notices of Professional Books, either Foreign or English.

It is requested that communications or books for review may be addressed to Colonel Lonsdale Hale, at the Royal United Service Institution, Whitehall Yard, London, S.W.

THE GERMAN ARMY IN 1886.[1]

By Major J. S. Rothwell, R.A., Professor of Military Administration, Staff College.

I.—Organization of the German Army.

By most readers of the Journal of the Royal United Service Institution it will be admitted that the German Army of the present day, though not the largest of the Continental forces, is that which is most completely organized, and consequently most efficient. Before proceeding to an examination of the details of the German military organization, it will therefore be of interest to enquire as to the cause of this pre-eminence of the German Army, as a fighting machine, over the armies maintained by other Great Powers.

It is clear that the cause is not to be found in any special combativeness inherent in the German, whom we are accustomed to regard as stolid and peace-loving, and whose philosophical temperament is less suited, apparently,

[1] The following works have been consulted in the preparation of this paper:—"The Armed Strength of the German Empire," Official, London, 1876; Baron Kaulbars' "Report on the German Army," Paris, 1880; Baron Stoffel's "Military Reports," Translation, Official, London, 1872; "L'Armée Allemande sur le pied de Guerre," Chef de Bataillon Rivière, Paris, 1884; Deutschland's "Streitkräfte," Vienna, 1882; "La Revue Militaire de l'Étranger," and other periodicals.

for the desperate ventures of the battle-field, than the impetuous disposition of the Italian or the Frenchman. In modern war, however, the result is less often decided by some exceptional feat of arms than by the perfection of the arrangements which enable a leader to count upon his troops being in a thoroughly efficient state at a certain place by a certain time, and it is in the painstaking accuracy by which such results are ensured that the German peculiarly excels. But the German soldier is more than a part of a great machine which works with astonishing exactness. He is intelligent and highly educated,[1] and has moreover an imaginative side to his character, which enables him at the call of duty to perform deeds of heroism equal to any that are recorded in military annals, for the sake of that Fatherland which he regards with an almost romantic affection.

Such is the material of which the German Army is made, and on the utilization of this material it will be seen that a surprising amount of sagacity has been brought to bear. In their treatment of military problems the Germans have made but few mistakes, and this must doubtless be attributed to the fact that the Army commands the services of the best talent in the nation. While in most other States the political, diplomatic, or legal career attracts the young men of the highest ability, leaving those of inferior capacity to fill the posts in the Army, it is otherwise in Germany. There the Army, besides being held in higher esteem than any other profession, actually has in its ranks for a time a large number of those who contemplate following some other pursuit, and by the prizes which it holds out can retain the services of a great proportion of the ablest men that the nation can produce.

Development of the German Army.—The German Army of the present day may be considered as a comparatively modern institution; for though it inherits the glorious traditions of the Army of Frederick the Great, its constitution was so radically changed in the early part of this century that for our present purpose it is unnecessary to go back further than the reconstruction which followed the disastrous campaign of 1806–7. Prussia was at this time so completely at the mercy of her conqueror that she was forced to submit to any terms which he was pleased to impose; and by the Paris Convention of 1808 Napoleon decreed that for ten years the standing army to be kept up by Prussia should not exceed 42,000 men of all arms,[2] and that the militia should not be called out.

At the end of 1808, therefore, we find that Prussia, whose Army at the outbreak of war in 1806 had amounted to about 250,000, had no more than the stipulated number in her ranks, and was thus supposed to have been reduced to impotence. On the collapse of her military power before the armies of Napoleon, a Military Commission had however been at once appointed, and this Commission, which included the best men available, such as Scharnhorst, Gneisenau, and Clausewitz, recommended the adoption of a system by which Napoleon's restrictions were rendered nugatory. The plan decided on by the King, on the advice of these distinguished Officers, was to dismiss to their homes all soldiers who had completed their course of instruction in drill, and replace them at once by recruits, who in their turn were sent back to civil life directly they had become trained soldiers. In this way the Army was neither more nor less than a great military school, and though

[1] Of those who come before the recruiting authorities, only 1·5 per cent. are illiterate.

[2]

Guard	6,000
Infantry (10 regiments)	22,000
Cavalry (8 regiments)	8,000
Artillery, Sappers, &c.	6,000
	42,000

no more than the authorized 42,000 men were ever at one time in its ranks, it was able to pass out every year some 20,000 well-drilled soldiers, who could be recalled to the colours when the occasion for their employment might arise.

At the beginning of 1813 the Prussian landwehr first received a definite organization, and the military forces of the country were thus increased, nominally, by 109,000 men. The training, or, as it was generally called, the "Krümper" system, had by this time been more than four years at work, so that when hostilities were this year resumed, the regular troops of Prussia were over 130,000 strong, in addition to which there were the 109,000 of the landwehr. Prussia was thus in a very different position from that which Napoleon had intended her to occupy, and as his power was now on the wane, the further development of her military organization was taken in hand even while her armies were in the field.

At the end of the campaign of 1814 no time was lost in giving effect to the improvements which had been decided on, and this year saw the Prussian forces organized on a basis which, with some modifications, is that which exists at the present day. The principle of general obligatory service was accepted, and in order to avoid the expense of keeping a very large number of men under arms in peace-time, each unit was given a comparatively small establishment, to be raised on the outbreak of war to the full strength, by recalling to the ranks those who had been sent on furlough after completing their course of military training. The Army was to consist of three main portions; the standing army, the landwehr, and the landsturm. Of these the standing army was composed of men serving with the colours and those in the reserve; the landwehr of two sections, called the 1st and 2nd bans, all the members of which had already served in the standing army; while the landsturm embraced all men capable of bearing arms who were not actually enrolled in either the standing army or the landwehr. The obligation to military service extended from a man's 17th to his 49th year, so that every individual in the nation capable of bearing arms was during this portion of his life enrolled in one of the three portions of the Army.

Under ordinary circumstances a man served in the standing army from his 20th to his 25th year, the first 3 being with the colours and the 2 latter in the reserve. He then passed into the first ban of the landwehr for 7 years, and on leaving this at 32 years of age joined the second ban for another 7 years, after which, being now 39, he became a member of the landsturm for 10 years. Before joining the colours, however, he had become liable to service in the landsturm on attaining the age of 17 years, and if from any cause a man did not join the standing army and complete the regular course of service in it and the landwehr, he still remained a member of the landsturm until he reached the age of 49, when his military liability ceased.

By the Law of 1814, the number of young men who were to join the Army each year was fixed at 40,000, but as the population of Prussia increased, it became necessary to call up a larger number each year, in order to carry out the original idea that the bulk of the young men attaining the military age should pass through the ranks of the Army. This, change, however was not effected in proportion as the population increased, but the yearly contingent remained at the former figure till 1860, when a Bill was introduced by which the contingent was to be raised to 60,000 men, and important changes in the organization of the Army were proposed. By this measure, which became law some years later in spite of serious opposition, the time of service in the standing army and reserve was increased from five years to seven, and the fourteen years in the landwehr were reduced to twelve, five in the first ban, and seven in the second.

With certain modifications this is the system in force in Germany at the

present day, and it is instructive to note that only one important measure of army reform has been introduced in Prussia in seventy-two years. The stability thus given to the military institutions of the country has had an important effect, and has enabled the German soldier to feel assured that a change in his position will not be lightly made, and that his old traditions will not be subjected to rash interference.

During the fifty years which followed the peace of 1815, France still posed before the world as the great military nation of Europe, and while the somewhat slow and methodical manœuvres of the German were sneered at as being antiquated and out of keeping with modern military science, the numerical strength of the Prussian Army was not so great as to suggest the possibility of its being able to hold its own against the larger forces of the other great military Powers. The results of the war with Austria in 1866, however, convinced all who were capable of forming a just judgment that the Prussian Army was something very different from the stiff, barrack-yard, military machine which it had been the fashion to consider it, and that its success, instead of being explained away by the superiority of the needle-gun, was really attributable to the perfection of its organization, and the care taken in peace-time to fit all branches of the Service for the parts which they would have to play in war.

The most important change in organization which followed the war of 1866 was that relating to the landwehr, service in which was now made to terminate at the end of the five years formerly passed in the first ban, instead of extending over twelve years as had been the case under the system established in 1860. The conclusion of the war with France brought with it no alteration in the conditions of service, which have now remained unaltered for nearly twenty years, and are in all important particulars based on the report of the Military Commission which was assembled in 1808.

The conditions under which German subjects perform their military service to the State having been thus set forth, we may turn to the broader question of the organization of the Army as a whole. The principle which has been adopted is that which we know by the name of localization; that is, the maintenance of a definite connection between a certain province or district and a corresponding portion of the Army. In our Service this system of localization has only been applied to the comparatively small units of infantry regiments and Divisions of artillery, but in Germany every military unit, up to and including the Army Corps, has a corresponding locality with which it is indissolubly connected.

Army Corps Organization.—Each of the larger provinces or kingdoms of which the German Empire is now composed has thus its own Corps, but all are similarly armed, equipped, and organized, and are equally under the control of the Emperor. The Corps which formed the Prussian Army in the earlier part of the present century were as follows:—

Guard.[1]—I Corps, Prussia; II Corps, Pomerania; III Corps, Brandenburg; IV Corps, Saxony; V Corps, Posen and Silesia; VI Corps, Silesia; VII Corps, Westphalia and Rhine Provinces; VIII, Rhine Provinces.

These military divisions have remained practically the same up to the present time, but after the war of 1866, when Prussia replaced Austria as the head of the German Confederation, three additional corps were enrolled in the Prussian Army, and numbered IX, X, and XI. These corps were furnished by the new provinces annexed by Prussia after that war, viz.:—Sleswig-Holstein, Hanover, Nassau, and Hesse-Cassel, and a Division, which has never been incorporated in any Army Corps, was also added to the Prussian Army, by absorbing the troops of the Grand Duchy of Hesse. The

[1] The Guard has never had a special district.

German Army then consisted of twelve complete Army Corps and an independent Division, but before the outbreak of the war with France in 1870 it was further increased by the Saxon Army, which became the XIIth Army Corps. The troops of Wurtemberg and Baden which took part in the war against France now form the XIIth and XIIVth Corps, and Alsace and Lorraine, which were annexed to the German Empire after that war, are garrisoned by the XVth Corps, which is formed of units of infantry and cavalry detached from all other Corps except the Guard. These sixteen corps, with the Hessian Division, are supplemented by the two corps maintained by the kingdom of Bavaria, which though organized on the same principles as the other corps, are not put on the same numerical list, but remain the Ist and IInd Bavarian Corps. The following table gives the German Army Corps as they stand at the present time :—

Army Corps.	Province.	Head-quarters.	Commander.
Guard	..	Berlin	General von Pape.
I	Prussia	Königsberg	Lieut.-Gen. von Kleist.
II	Pomerania	Stettin	General von Dannenberg.
III	Brandenburg	Berlin	Lieut.-Gen. Count von Wartensleben.
IV	Saxony	Magdeburg	General Count von Blumenthal.
V	Posen	Posen	General von Stiehle.
VI	Silesia	Breslau	Lieut.-Gen. von Wichmann.
VII	Westphalia	Münster	General von Witzendorff.[1]
VIII	Rhenish	Coblenz	Lieut.-Gen. Baron von Loë.
IX	Sleswig-Holstein	Altona	General von Tresckow.
X	Hanover	Hanover	Gen. Prince Albert of Prussia.[1]
XI	Hesse-Cassel	Cassel	Gen. Baron von Schlotheim.[1]
XII	Saxony	Dresden	Gen. Prince George of Saxony.
XIII	Wurtemberg	Stuttgard	General von Schachtmeyer.
XIV	Baden	Carlsruhe	General von Obernitz.
XV	Alsace and Lorraine	Strasburg	Lieut.-Gen. von Heuduck.
I Bav.	South Bavaria	Munich	General Baron von Horn.
II Bav.	North Bavaria	Wurzburg	General von Orff.
Hessian Division	Hesse	Darmstadt	Lieut.-General Prince Henry of Hesse.

The composition of these various Army Corps is similar, though not absolutely identical. Each consists of two Infantry Divisions, and a Rifle Battalion, with force of Cavalry varying from twenty to forty squadrons, as a rule attached to the Infantry Divisions, nineteen batteries of Artillery, a force of Foot Artillery, a Pioneer Battalion, and a Train Battalion.

The following table shows the distribution of the troops in Army Corps in time of peace, but in some instances additional troops are attached, as in the case of the XVth Corps, which is strengthened by the addition of the Foot Artillery Regiment of the XIIth Corps, and a Battalion of the 2nd Bavarian Foot Artillery Regiment, as well as by a Brigade of Bavarian Infantry :—

[1] Cavalry Generals.

Corps.	Divisional troops.			Corps artillery.			Cavalry divisions.				
	Battalions.	Squadrons.	Field batteries.	Horse artillery batteries.	Field batteries.	Rifle battalions.	Regiments.	Squadrons.	Fortress artillery companies.	Pioneer battalions.	Train battalions.
Guard	27	..	8	3	8	2	8	40	8	1	1
I	30	..	8	3	8	1	5	25	8	1	1
II	27	30	8	3	8	1	..	..	16	1	1
III	24	30	8	3	8	1	..	..	8	1	1
IV	24	20	8	3	8	1	..	..	8	1	1
V	27	25	8	3	8	1	..	..	8	1	1
VI	27	25	8	3	8	1	..	..	8	1	1
VII	27	20	8	3	8	1	..	..	8	1	1
VIII	24	20	8	3	8	1	..	..	8	1	1
IX	24	20	8	3	8	1	..	..	4	1	1
X	24	25	8	3	8	1	..	..	..	1	1
XI	27	20	8	3	8	1	..	..	..	1	1
XII	30	..	8	2	10	2	6	30	8	1	1
XIII	21	20	8	..	8	..	..	..	4	1	1
XIV	24	20	8	1	8	..	..	..	4	1	1
XV	27	..	8	..	8	1	7	35	8	2	1
I Bav.	27	25	8	3	8	2	..	..	8	1	1
II Bav.	30	25	8	3	8	2	..	..	8	1	1
Hessian Div.	12	10	4	1	..	..	..	..	..	..	0¼
	483	335	148	46	146	20	26	130	124	19	18¼

In the Army Corps, other than the Guard, the Infantry Divisions are numbered throughout consecutively. Thus the Ist Army Corps is composed of the 1st and 2nd Divisions, the IInd Corps of the 3rd and 4th, and so on to the XIIth, which is composed of the 23rd and 24th Divisions. The independent Hessian Division, which is attached to the XIth Corps, is counted as the 25th, so that the XIIIth Corps consists of the 26th and 27th Divisions the XIVth of the 28th and 29th, and the XVth of the 30th and 31st. The Infantry Brigades, of which there are two to each Division, are similarly numbered, the 1st Division consisting of the 1st and 2nd Brigades, the 2nd of the 3rd and 4th, and so throughout to the 31st Division, which consists of the 61st and 62nd Brigades.

The Bavarian Corps also consist of two Divisions each, but these as well as the brigades of which they are composed, have a separate enumeration, distinct from that of the Prussian Corps.

It will be seen from the table given above that in peace-time, except in the Guard, Ist, XIIth, and XVth Corps, the German Cavalry is not formed into independent Divisions, but is attached to the Infantry Divisions. This would not be the case in time of war, as the bulk of the cavalry would then be formed into Cavalry Divisions, and only one regiment of cavalry assigned to each Infantry Division, but with this exception the German Army Corps carries with it into the field the same organization that it has in time of peace.

Under no circumstances is one Army Corps made dependent on another, or on a central establishment outside its own province, for the supply of any stores or supplies necessary for it. Each corps is practically as independent and self-contained as if it were the army of some minor sovereign State, so that the preparations for taking the field can be carried on simultaneously in all, without any clashing of interests. This principle of decentralization has been so thoroughly carried out that as soon as the orders are issued to the Army Corps Commanders, each of these Generals can at once proceed to give effect to them, without further reference to the Imperial Headquarters in Berlin.

The same principle is also apparent in smaller units, the commanders of which are made as far as possible independent, and able to complete all preparations directly the mobilization orders reach them.[1]

Landwehr.—In the table on p. 307, only the troops of the standing army have been referred to, but in addition to these the Army Corps Commander has under his orders the various units of the landwehr which belong to his district. The landwehr, as mentioned already, is a sort of militia in which men who have served for seven years in the standing army and reserve are enrolled, and in which they continue to serve for a period of five years; this period extending under ordinary circumstances from a man's 27th to his 32nd year. In time of peace the units, on the rolls of which these men's names are inscribed, have no existence as military bodies; only the cadres, or as we call them the "Permanent Staff," being kept up, in the case of the landwehr infantry battalions.[2] The landwehr, however, is not exclusively an infantry force, as it has an establishment of cavalry and artillery, but for these no cadres are maintained in time of peace, and they only commence to have an existence on the outbreak of war.

As a rule two landwehr battalions correspond to each infantry regiment, so that the number of landwehr battalions for whom cadres are maintained in time of peace is 300. If the rule were strictly followed the number would be 322, but in the case of the more recent additions to the German Army, the organization adopted in the older corps has not been closely adhered to. In consequence, however, of certain changes which were made in 1881, the number of landwehr battalions will increase progressively after 1888, and in 1893 will reach a total of 328. Landwehr infantry are formed into reserve regiments, brigades, and divisions, when required for active service.

The cavalry of the landwehr would in time of war consist of 24 reserve regiments, and 50 dismounted squadrons, and the artillery would be organized in 55 batteries; these troops being as a rule attached to the reserve divisions just mentioned, but also employed otherwise as they might be required.

Landsturm.—The landsturm has no military organization laid down either for peace or war. It is merely a list of those male inhabitants of the country who are of military age and fit to serve, whose names are not entered on the rolls of the standing army, the reserve, or the landwehr. A struggle which would necessitate the calling up of this force would be one in which the very existence of Germany as a Power would be at stake; for even in the War of 1870–71 it was never found necessary to have recourse to the landsturm, but if such an emergency should arise, the men belonging to this force would be drafted into the landwehr to fill vacancies in its ranks, and formed into newly raised landsturm regiments, to take a part in the defence of the country.

[1] It may be observed that there is telegraphic communication to every barrack throughout the Empire.

[2] These battalions may be called out for training, every man while in the Landwehr being liable to attend two trainings, each of 14 days.

II.—Infantry.

The German infantry of the standing army consists of 161 regiments of Guards, and Line, and 20 battalions of rifles. Regiments of Guards and line are further distinguished as Grenadiers, Infantry, or Fusilier Regiments, but these distinctions, like the corresponding titles in our own Service, have now ceased to have any military significance, and all these regiments are expected to perform similar duties.

The Infantry of the Guard consists of 9 regiments; viz.: 4 regiments of Foot Guards, 4 regiments of Grenadiers of the Guard, and 1 regiment of Fusiliers of the Guard.

There are 19 regiments of Grenadiers, of whom 12 are Prussian, 1 Mecklenburg, 2 Saxon, 2 Baden, and 2 Wurtemberg.

Of the 13 Fusilier regiments, 11 are Prussian, 1 Mecklenburg, and 1 Saxon.

Each regiment consists of three battalions, of which one is always[1] styled a "Fusilier" battalion, the other two battalions in Guard regiments being called Grenadiers, and in the line Musketeers. These Fusilier battalions, unlike the Fusilier regiments, are intended for employment somewhat different from that of the other battalions, being used as light infantry, while the Grenadier or Musketeer battalions are for general service. All battalions, however, have a similar establishment, each consisting of four companies, which are not numbered independently for each battalion, but consecutively from 1 to 12 throughout the regiment.

Company.—The establishment of a company in peace and war is as follows:—

	Peace.	War.
Captain (Hauptmann)	1	1
1st Lieutenant	1	1
2nd Lieutenants	2	3
Sergeant Major-(Feldwebel)	1	1
Vice-Sergeant-Major	1	1
Portepée Fähnrich	1	1
Sergeants	4	4
Non-commissioned officers	7	13
Lance-corporals	13	24
Privates	106	202
Drummers	2	2
Buglers	2	2
Hospital Assistants	1	1
Train soldier	—	1
Tradesmen	3	—
	145	257

The Captain of a German infantry company is a mounted Officer; being allowed forage for one horse in peace and two in war. The Portepée Fähnrich is a candidate for a commission, who takes rank after the sergeant-major and vice-sergeant-major, and is generally armed with a rifle.[2] Each of the four sergeants is in charge of a section of the company, and they, as well as the other non-commissioned officers, carry rifles, so that each com-

[1] The 89th Mecklenburg Grenadiers is an exception to this rule, as it consists of three grenadier battalions, and in Saxon and Bavarian regiments the rule is not observed.

[2] He carries a rifle until he has passed the examination for Officer's rank, when he is given a sword, and ranks above the sergeant-major.

pany on war strength has 243 or 244 rifles, according as the Fähnrich is or is not armed in this way.

Of the 257 individuals forming a German company, all are combatants except the hospital assistant and the train soldier, but in the ranks there are four men trained as stretcher bearers, who though armed with rifles do not take their places in the ranks during an action, but are placed at the disposal of the medical Officer.

Battalion Staff.—An infantry battalion, which consists as already mentioned of four companies, has in addition the following staff :—

	Peace.	War.
Battalion Commander (Major)	1	1
Adjutant (Lieutenant)	1	1
Surgeons	2	2
Paymaster	1	1
Clerk	1	1
Drum-major	1	1
Armourer	1	1
Train soldiers	—	16
Sutlers and assistants	—	4
	8	28

The battalion commander is allowed forage for 2 horses in peace and 3 in war, the Adjutant for 1 in peace and 2 in war, and the Surgeons and the Paymaster 1 each in war, so that the riding horses of the battalion staff are 3 in number in peace and 8 in war.

There are no wagons or draught horses with a battalion in peace, but in time of war each infantry battalion has 9 vehicles[1] and 24 draught horses. The complete peace establishment of a battalion thus amounts to 588 of all ranks, with 7 riding horses, and the war establishment to 1,056 of all ranks, with 16 riding horses, 24 draught horses, and 9 vehicles. Colours are carried by each infantry battalion, except in the 108th Saxon Regiment.

Regimental Staff.—An infantry regiment consists of three battalions of similar strength, the regimental staff being as follows :—

	Peace.	War.
Regimental Commander	1	1
Field Officer for interior economy	1	1
Supernumerary Captain	1	—
Adjutant	1	1
Staff Surgeon-major	1	1
Clerk	1	1
Musicians	10	10
Train soldiers	—	7
	16	22

The regimental commander is allowed forage for 3 horses in peace and 5 in war; the Field Officer and Adjutant for 2 in peace and 3 in war; and the Staff Surgeon-major for 2 in war; the riding horses of the regimental staff thus numbering 8 in peace and 13 in war. There is only one vehicle belonging to the regimental staff, viz., a two-horse baggage wagon, so that the complete peace establishment of an infantry regiment amounts to 1,780

[1] 1 six-horse ammunition wagon, 1 four-horse battalion baggage wagon, 4 two-horse company baggage wagons, 1 two-horse pharmacy wagon, and 2 two-horse sutler's wagons. These are kept in peace-time at the headquarters of the regiment.

of all ranks, with 29 riding horses, and the war establishment to 3,190 of all ranks, with 61 riding horses, 74 draught horses, and 28 vehicles.

It will be noticed that on the staff of an infantry regiment there are only ten musicians, but the regimental bands are brought up to a strength of about forty-two performers by attaching two or three men from the ranks of each company. These men, however, being equipped and trained exactly like their fellows, have been included among the combatants.

The supply of ammunition and of food for a German soldier when on active service is provided for as follows:—As regards ammunition, each infantry man carries 80 rounds on his person, viz., 40 in two pouches on the waist-belt, and two packets of 20 each in a pocket at each side of the knapsack. Twelve rounds more per man are carried in the company wagon, and 20 in the battalion wagon, so that with the regiment there should be 112 rounds per man. The first reserve of ammunition is carried in the Army Corps ammunition columns, and provides for 60 rounds per man additional, so that 172 rounds per man are actually carried with a mobilized Army Corps.

On service, rations are issued in the usual way wherever this is possible, but to meet the case of an advancing force pushing far ahead of its trains, each infantry regiment has with it three days' provisions per man, which are called the "iron ration,"[1] and must not be touched except on the direct order of the General Commanding. These rations are partly carried by the men themselves and partly in the wagons, but they must always be with the troops, as well as three days' oats for each draught horse.

Rifles.

Rifle battalions differ in no material respect from other infantry battalions, but being recruited exclusively from among the foresters they are specially valuable for service in a difficult country, on an advanced guard, or in any circumstances where a single battalion has to be employed. Of the 20 battalions of which the force consists, there is 1 of Rifles of the Guard and 1 of Sharpshooters of the Guard; 11 Prussian rifle battalions, 2 Saxon, 1 Mecklenburg, and 4 Bavarian.

There is no battalion ammunition wagon as in infantry regiments, but 40 rounds per rifle are carried in the company wagons, so that riflemen have close at hand a total of 140 rounds per rifle.

Training of Recruits.—We may now turn to the system which is adopted for the training of the infantry soldier. Each company receives in theory the same number of recruits annually,[2] but as the casualties in some companies are more than others, they are practically brought up each year to the regulated establishment. The number amounts to nearly one-third of the company establishment, or about forty-eight, and these men join generally at the beginning of November, about four weeks after the reservists whom they are to replace have proceeded to their homes.

During the interval which has elapsed since the departure of the reservists, everything necessary for the reception of the new comers has been prepared by the Captain of the company, and the recruits are at once told off to the rooms they are to occupy, each room having for its head a specially selected lance-corporal to maintain order and teach them their duties. These lance-corporals are 10 or 12 in number for each company, 3 or 4 being told off to each of the 3 squads into which the 48 recruits are usually divided. Each squad is under a non-commissioned officer, who with the aid of the lance-

[1] Consisting of biscuit, bacon, or preserved meat, rice, coffee, and salt.

[2] The number per battalion is fixed by Imperial Decree each year, and has stood at 190 for a considerable period.

corporals drills the recruits composing it, and lives as much as possible in their company. The supervision of the whole course of instruction of the recruits is entrusted to one of the Lieutenants of the company, who, like the non-commissioned officers, has been selected by the Captain on account of being specially suited for this work by reason of his attainments, good temper, and firmness. The course of instruction is accurately laid down by regulations which the instructors are obliged to follow, but beyond seeing that the rules are complied with, the Captain interferes little with the training of the recruits. Here, as in more important matters, the principle is that no duty is assigned to an Officer who is not considered to be capable of performing it satisfactorily, but that when the work has been begun, the responsible Officer is left to his own judgment as to the mode in which he will carry it out, knowing that he will be judged by the result.

On his first arrival the recruit is served out with his uniform, not by any means new, but still sufficiently clean and smart looking to induce him to take a pride in his cloth, and he is taught by the head of his room how to clean his accoutrements and how to put them on. Drill is at first made comparatively easy to the young recruit, who during his first week is only kept on parade for two hours in the morning and an hour and a half in the afternoon, but the next week half an hour is added to the length of both parades, and in the fourth week he is drilled for two hours and an half on each occasion. The arrangement of the recruits' course of instruction is left entirely to the discretion of the Captain of the company, who in his turn leaves great freedom of action as to details to the Lieutenant-Instructor. Thus the different companies of the same regiment may proceed in the training of their recruits on totally different lines, some Captains for instance commencing the manual exercise as early as the third day of a recruit's service, while others do not place arms in his hands till a considerably later date. With the different systems which may be adopted the Commanding Officer is careful not to interfere; all he concerns himself with is that when the inspection of the recruits takes place they shall come up to the prescribed standard.

The inspection is usually made about the 1st March, and the recruits have consequently had by this time some twelve or fourteen weeks' training, within which period it is expected that they will have thoroughly learnt all parade movements, and how to manœuvre in dispersed order. They must also be trained in gymnastics, in the use of their arms, aiming drill and bayonet exercise, as well as in the methods of keeping their arms, clothing, and accoutrements in serviceable condition. They must be familiar with all bugle calls, and have a general acquaintance with the articles of war and military regulations; information on the last-mentioned subjects being given in the winter evenings by the Lieutenant to whose care the recruits have been confided.

The inspecting Officer whose duty it is to see that the recruits have been properly trained is the Colonel of the regiment, and the very close examination which he makes of every individual recruit, obliges him to spend about two hours over the inspection of each company. So much importance is attached to this inspection that it is by no means unusual for the General Commanding the Army Corps to be present at it, and the keenest interest is taken by Officers of all ranks in the success or failure of the different systems adopted in the various companies.

On the day following the recruits' inspection they are passed into the ranks of the company, and thenceforward do duty in all respects as the old soldiers.

It is to be remarked that in thus transforming raw recruits into soldiers fit to take their place in the ranks in such a short space of time as three months, the process is materially assisted by the military training which all young

Germans receive while at school, as well as by the high standard of education diffused throughout the nation. The Lieutenant-Instructor of the company has not to waste his time on hopelessly ignorant dullards, but can count on every recruit with whom he has to deal having a good elementary education, and being thus able to benefit by the teaching which is to fit him for his duties as a soldier.

When the recruit drills are terminated and the company is brought up to its full peace establishment, the spring drills commence, and it may be remarked that in the prosecution of the extended series of exercises which are included under this head, the young soldier's instruction is comparatively little interrupted by guards and fatigues. On the average the German infantry soldier has about ten or eleven nights in bed, and every effort is made to reduce the number of men employed both on guard and on fatigue duties. Thus on any post where a sentry in the day time can be dispensed with, only a night sentry is employed, and the number of purely honorary sentries, at the gates of palaces, &c., is reduced to a minimum.

In the earlier part of the spring drills the men are exercised in route-marching by companies, and practised in constructing bivouacks and placing outposts. These marches are succeeded by company drill, in which the movements are simple, but where the men are taught to act with the utmost promptitude on their Captain's orders, whether those orders are in accordance with what is laid down in the regulations, or something totally different. By this system of making irregular and unexpected movements, the company becomes extraordinarily handy, and the men learn to obey a word or a sign from their Captain with mechanical accuracy.

The company drills last for about six weeks, and at their conclusion each company is inspected by the Colonel of the regiment, who, on finding the condition of all satisfactory, orders the commencement of battalion drill. This is now practised three days a week for about four weeks, the remaining days being devoted to company drill and rifle shooting. The battalion exercises are at first merely drill, carried out simply with the object of making the battalion easily handled and flexible, but afterwards every sort of field manœuvre which can occur in actual war is practised under the best conditions which can be obtained.

At the close of these drills each battalion is inspected by either the Brigade or Divisional Commander, these inspections usually taking place about the beginning of June.

In the course of the summer, whenever it is practicable, the three battalions of the regiment are manœuvred together, and at some stations brigade drill is practised, but very often when the battalion drills are completed, the troops are at once exercised in minor tactics. This work is done at first by companies, each Captain marching his men out into the country and teaching them in a practical way how to make themselves secure by outposts and patrols, while on the march out and homewards one half of the company is sometimes sent on, representing the rear guard of a retreating force, the other half representing the advanced guard of the pursuers, and endeavouring to keep the first in sight. The formation of bivouacks and the best ways of crossing hedges, ditches, and other obstacles are also practised, as well as the attack and defence of posts, and the construction of shelter trenches and simple field works. Swimming is taught universally, and concurrently with the above-mentioned exercises the troops of all ranks are constantly engaged in rifle practice.

Musketry.—The German military authorities act on the principle that the better the rifle with which the men are armed, the more important it is to teach them to use it properly; and hence the attention which is paid to musketry instruction is large and increasing in amount. Ball practice com-

mences in many instances before the recruit has finished his drill, the number of rounds fired on each occasion being as a rule limited to five, so that the men may not be tired or disgusted. For every infantry soldier, including Officers, an annual allowance of 130 rounds of ball cartridge is given, and some extra rounds beyond this number are assigned to those men who prove themselves to be bad shots. Practice in barracks with the miniature ammunition and the aiming tube is also encouraged, the only restriction on this being that a lance-corporal must always be present while it is being carried on.

The whole of the musketry instruction is carried out by the Officers and non-commissioned officers of the company, the men being united for instructional purposes in small squads of ten or twelve, so that every individual is brought directly under the eye of the Officer or non-commissioned officer who is responsible for his training.

The only time of the year when rifle practice is not going on is during the grand manœuvres, which take place every autumn. With these the military year may be said to terminate; for at their conclusion the reservists proceed to their homes, and preparations are made for the new batch of recruits who, as mentioned already, join each company in the month of November.

III.—CAVALRY.

There are 93 regiments of German cavalry, of which 10 are cuirassiers, 2 Saxon heavy cavalry, 2 Bavarian heavy cavalry, 28 dragoons, 20 hussars, 6 Bavarian light cavalry, and 25 uhlans or lancers.

The regiments are classed as guards and line, the guard cavalry being composed of 2 regiments of cuirassiers, 2 of dragoons, 1 of hussars, and 3 of uhlans. These are all Prussian regiments, but the cavalry of the line is made up of contingents from the various States. Thus Saxony furnishes 2 regiments of heavy cavalry, 2 of hussars, and 2 of uhlans. Bavaria has 2 heavy cavalry regiments, 6 regiments of light cavalry, and 2 of uhlans. Mecklenburg has 2 regiments of dragoons, Oldenburg 1, and Baden 3. Brunswick has 1 regiment of hussars, Hesse 2 of dragoons, Wurtemberg 2 of dragoons and 2 of uhlans. The remainder, viz., 8 regiments of cuirassiers, 16 regiments of dragoons, 16 of hussars, and 16 of uhlans, are Prussian.

All these regiments are identical in their organization and establishment, each consisting of five squadrons, the squadron being again divided into four sections.

When ordered on active service, however, a regiment only takes the field four squadrons strong, the remaining squadron being left behind as a depôt squadron, and giving up to the service squadrons its trained men and horses in place of the recruits and inferior horses that may happen to be in the ranks when the orders arrive. The regiment can thus at the shortest notice take the field with four thoroughly efficient squadrons, while its requirements during the campaign are supplied by a system which requires the introduction of no fresh machinery. The squadron which thus acts as the regimental depôt differs in no respect from the other squadrons, as the liability to be thus left behind, in case war should break out, is undertaken by a different squadron each year, according to a regular roster.

The peace and war strength of a squadron are as follows :—

	Peace.	War.
Captain (Rittmeister)	1	1
1st Lieutenant	1	1
2nd Lieutenants	2–3	3
Sergeant-major (Wachtmeister)	1	1
Vice-Sergeant-major	1	1
Portepée Fähnrich	1	1
Sergeants	4	4
Non-commissioned officers	8	8
Lance-corporals	20	20
Trumpeters	3	3
Troopers	96–97	112
Farrier	—	1
Hospital assistant	1	1
Train soldiers	—	6
Tradesmen	4	—
	143–145	163

The number of horses in peace is 140, and in war 174, including 2 draught horses for the squadron wagon. A squadron on war strength has 155 mounted combatants. A cavalry regiment, with 5 squadrons in time of peace and 4 in war, has the following staff:—

	Peace.	War.
Regimental Commander	1	1
Major for interior economy	1	1
Adjutant	1	1
Staff Surgeon-major	1	1
Assistant Surgeons	2	2
Staff Veterinary Surgeon	1	1
Veterinary Surgeons	4	2
Paymaster	1	1
Assistant Paymaster	1	—
Clerk	1	1
Trumpet-major	1	1
Armourer	1	1
Regimental saddler	1	1
Hospital assistants	5	—
Train soldiers	—	14
Sutlers and assistants	—	4
	22	32

The Officer commanding a cavalry regiment is allowed forage for 3 horses in peace time and for 5 in war, the Major for 2 in peace and 4 in war, the Captains for 3 in peace or war, and the Lieutenants for 2 in peace and 3 in war.

Regimental Transport.—Each cavalry regiment has in time of war its own transport, consisting of 8 vehicles,[1] drawn by 18 horses, and attended to by 7 of the train soldiers, the remainder of these men being told off as Officers' grooms.

The total strength of a cavalry regiment on peace strength amounts to 737 of all ranks, and in time of war to 684, of whom 667 are mounted, the number of mounted combatants being 624.

[1] 1 four-horse headquarters' wagon; 4 two-horse squadron wagons, with portable forge; 1 two-horse pharmacy wagon, and 2 two-horse sutler's wagons.

Ammunition.—Each cavalry soldier who is armed with a carbine carries 50 rounds of ammunition, 20 being in his pouch and 30 in the wallets. Non-commissioned officers and others who have revolvers instead of carbines, carry 18 rounds each, or three complete charges for the six-chambered weapon with which they are armed. No ammunition is carried in the wagons of a German cavalry regiment, so that if a further supply is required, it must be obtained from the Army Corps ammunition columns, unless the regiment forms part of an independent Cavalry Division, in which case recourse might be had to the attached ammunition wagons, in which about 12 rounds per carbine are conveyed.

Iron Rations.—Iron rations for cavalry men are exactly the same as for infantry, and one day's iron ration of oats is carried for every troop horse.

Tradesmen Division.—Among the non-combatants attached to each cavalry regiment, and left behind when the regiment goes on active service, are 20 tradesmen, 4 for each squadron. These are attached to the depôt squadron, and their numbers are increased to 60 of all ranks, thus forming a tradesmen division, whose duty it is to keep the regiment supplied with equipment of all sorts while in the field. They are under the superintendence of the Assistant Paymaster, who is detached from the regiment for this purpose.

The German cavalry are classed as heavy and light; cuirassiers and lancers being counted as the former, and dragoons and hussars the latter. Two to four regiments constitute a brigade, these brigades bearing the same numbers as the infantry Divisions to which they are attached. Where a cavalry brigade consists of an even number of regiments, they are usually half heavy and half light; but in the brigades which have three regiments, no fixed relation seems to be observed.

Horses.—Horses for the German cavalry are as a rule provided from the twenty remount depôts, where they have been kept for a year or two, after having been purchased as three-year-olds, at an average price of about 34*l*. They are expected to last for eleven years, but a certain number of those which, at the end of this period are still fit for work, are only provisionally cast, and are retained for the instruction of one-year volunteers. Forage for these horses is supplied as well as for some supernumerary horses, which to the number of three or four may be kept by each squadron. In peace-time these supernumerary horses are used for drawing forage, and for the regimental transport during manœuvres, when, the regiment being still on the peace footing, no draught horses are provided, but on mobilization they are at once taken on the strength as effectives.

Subalterns' horses are supplied by the State, a few superior animals being sent from the remount depôts for this purpose. Such horses, after having been five years in the Officer's possession, become absolutely his property; but an Officer who exchanges or leaves his regiment cannot take with him a horse which he has had for less than the full period. In such a case he would receive a sum of money representing his interest in the animal, proportionate to the length of time during which it has been in his care. If a charger is not supplied, a payment in money is issued, the amount allowed being about 25*l*. The number of remounts annually required in peace-time in the German Army for cavalry, artillery, and train amounts to about 6,000, and these are told off at the depôts to the branch of the service for which they are best suited. Each cavalry regiment, battery, &c., sends a detachment to the depôt from which it procures its remounts, and the men of this detachment take the horses back with them by railway, all the remounts thus reaching the corps at or about the same time, viz., in the month of July.

Each cavalry regiment receives sixty-three horses annually, giving twelve or thirteen to each squadron, exclusive of Officers' chargers, and this number

is never exceeded. If the squadron commander feels constrained to cast more than thirteen horses, or if in the course of the year some of the horsse die, his squadron must remain below its establishment till the following year, when by casting less than thirteen, he can again bring his troop horses up to their proper number.

The number of rations of forage issued to each squadron is always for the full number of horses on the establishment, whatever the actual number of horses may be. It consequently happens, where from any cause this number is below the establishment, that a certain amount of surplus forage will be drawn, and this forage the commander of the squadron has the right to sell, and with the money thus obtained, purchase another horse or horses to remove the deficiency. By this arrangement squadrons are seldom left much below their proper establishment, and all intricacies of correspondence about forage returns are avoided.

Training of Recruits.—The instruction of cavalry recruits is carried on in a manner similar to that adopted in the infantry. The recruits join at about the same season, viz., in October; but as in the cavalry a very large proportion of the recruits are four-years volunteers, who join on the 1st October, while the ordinary recruits do not join till a fortnight later, it follows that the annual quota for a squadron forms two parties which cannot conveniently be instructed together.

Each squadron receives annually thirty-five to forty-five recruits, and these are usually formed into three or four squads to be trained, as in the infantry, by selected non-commissioned officers, acting under the superintendence of the Lieutenant-Instructor. Recruits must attend the riding school for six months, no matter how well they may be able to ride before joining, and as there is no riding-master, this course is entirely in the hands of the squadron instructors.

Before a recruit can be dismissed he must be able to manage his horse perfectly under all circumstances and at all paces, to cross all fences or other obstacles which he is likely to meet, and to understand thoroughly the use of his arms. As recruits if left to themselves might charge too wildly for their own safety or of that of their horses, this part of the training is always practised in company with an equal number of old soldiers, one of whom is told off to each recruit, who must regulate his pace by that of his more experienced comrade.

On the 1st May the recruits' course of drill is ended, and they take their places in the squadron, as do also the last batch but one of remounts, which in the twenty-one months that they have been with the regiment have been thoroughly broken in. The newest remounts are also used, but as they are not considered to be efficient troop horses, they are left in the hands of the men who act as rough riders.

Squadron drill lasts for about six weeks, during which time the squadron commander is constantly exercising his men in the field, his main object being to impress them with the idea that there is no formation from which the squadron cannot instantly charge the enemy, no matter on what side he may make his appearance.

When regimental drill begins in June, these squadron drills are not discontinued, but each Captain takes out his squadron on the days when there is no regimental drill, every horse being expected to do at least five days' hard work in each week. Any spare time which the men may have is employed in foot parades and rifle shooting, 40 rounds being allowed annually for each carbine and 15 for each revolver. The regulated allowance of ammunition is however supplemented by 15 additional rounds of carbine ammunition issued annually for each of the 120 best shots in the regiment, and besides this some extra rounds are obtained in lieu of lead recovered from the

butts, so that a German cavalry soldier has frequent opportunities of practising shooting.

Among other exercises which form part of the course of instruction the swimming of rivers by cavalry is important. This is practised once a week in summer at all stations where there is a river of sufficient size within reach, and with regiments which have had some experience the horses plunge in without hesitation, and carry their riders with their arms and accoutrements in safety to the opposite bank. Every sort of duty which can fall to the lot of the cavalry soldier is practised, but the art of making a rapid reconnaissance, and of briefly reporting the most important points, is cultivated with peculiar care. A non-commissioned officer, for instance, detached for such a purpose would have the exact circumstances under which he is acting carefully explained to him, and it is needless to say that the preparation of such problems entails a considerable amount of work on the regimental Officers by whom they are drawn up, and that before being capable of setting such tasks to their men, they must be possessed of an ample store of military knowledge.

Such a course of training renders the German cavalry soldier extremely self-reliant, and qualifies him for the duty which is peculiarly his own, that of being the eyes of the army.

IV.—Artillery.

The German artillery is composed of two branches, viz., the field artillery and the foot or garrison artillery. The Officers and men of each of these branches belong to them permanently, and cannot be transferred from one to the other, this complete separation of the Officers having been carried out in 1872.

The field artillery is organized in regiments, two of which, with the ammunition columns, form a brigade, and one such brigade, with a regiment of foot artillery, is allotted to each Army Corps. One of the two regiments in a field artillery brigade is composed of two divisions, each of four field batteries, and this regiment furnishes the Divisional artillery, viz., four field batteries to each infantry Division. The other regiment of the field artillery brigade consists of three divisions, two of which are similar in composition to the divisions of the first regiment, while the third division is made up of three batteries of horse artillery; this regiment forms the corps artillery.

The field artillery with a German Army Corps amounts therefore to 19 batteries or 114 guns; of which 8 batteries or 48 guns are with the infantry Divisions, and 11 batteries or 66 guns are under the direct control of the corps commander, but of course when some of the horse artillery batteries are detached for duty with a cavalry Division, the corps artillery will be proportionally decreased.

As a rule, in time of peace only four guns of a German battery are horsed, the other two guns and the twelve carriages which are mentioned below being kept in store at the headquarters of the regiment.[1]

The peace and war establishments of a German field battery are as follows:—

[1] Four field batteries of the Ist Corps, four of the IInd, and eight of the XVth Corps have 6 guns each in peace. These batteries have 9 men and 16 horses extra. Of the horse artillery batteries, three of the VIIIth, one of the XIth, one of the XIIth, and one of the XIVth Corps have 6 guns each. These batteries have 1 trumpeter and 10 gunners extra, with 30 additional horses.

	Peace.	War.
Captain (Hauptmann)	1	1
1st Lieutenant	1	1
2nd Lieutenants	2	3
Sergeant-major (Feldwebel)	1	1
Vice-sergeant-major	1	1
Portepée Fähnrich	1	1
Sergeants	4	4
Non-commissioned officers	10	8
Corporals (Ober-gefreite)	4	6
Lance-corporals	6 or 7	9
Trumpeters	2	3
Gunners and drivers[1]	67 or 68	129
Train soldiers	—	5
Farrier	—	1
Saddler	—	1
Hospital assistant	1	1
	102	175

The establishment of a horse artillery battery is very similar as regards the men, the only difference being that both in peace and war there are 8 less non-commissioned officers and men, with 1 saddler extra in war.

The number of horses in a battery is as follows :—

		Peace.	War.
Field battery	Riding	16	32
	Draught	28	118
		44	150
Horse artillery battery	Riding	48	116
	Draught	28	114
		76	230

The twelve carriages which belong to a battery consist of eight ammunition wagons, three store wagons, and a forge wagon, all six-horsed.

Ammunition.—The number of rounds carried in time of war is as follows :—

		Gun limbers.	Ammunition wagons.	Total.
Field battery	Common shell	120	440	560
	Shrapnel	60	160	220
	Case	18	16	34
				814
Horse artillery battery	Common shell (light)	144	480	624
	Shrapnel (light)	72	192	264
	Case (light)	18	16	34
				922

Particulars as to the two natures of guns with which the German artillery

[1] Of the 144 corporals, lance-corporals, and privates in a field battery on war strength, 48 are gun numbers, 68 are drivers, and 28 are in reserve.

is armed will be given later (page 358), and it is only necessary here to observe that the field artillery gun is known as the 9-cm. gun, and the horse artillery gun as the 8-cm. gun. The axletree boxes of the field battery gun are fitted with seats, so that with three gunners carried on the limber, a field battery can bring up on the guns themselves a sufficient number of men to work them.

Ammunition Columns.—The two ammunition columns which have been mentioned as being part of a brigade of field artillery are only formed on mobilization. Each of them consists of two infantry and three artillery sections, which carry respectively small-arm and gun ammunition.[1] These columns, though part of the Army Corps organization, are thus readily attached to the two infantry Divisions, if this should be desirable, and are capable of still further subdivision, by assigning one section to each infantry brigade, supposing a case to arise where a brigade has to be employed independently.

In the 10 sections of the Army Corps ammunition column 60 rounds are carried for each infantry rifle and cavalry carbine, 121 rounds for each field battery gun, and 135 for each horse artillery gun, so that with a German Army Corps there are in all 172 rounds for each infantry rifle, 110 rounds for each cavalry carbine, 256 rounds for each field battery gun, and 288 rounds for each horse artillery gun.[2]

Foot Artillery.—The foot artillery regiment belonging to each Army Corps consists of two battalions, each of four companies. The establishment of a company of foot artillery is as follows:—

	Peace.	War.
Captain (Hauptmann)	1	1
1st Lieutenant	1	1
2nd Lieutenants	2	2
Laboratory sergeant (Feuerwerker)	1	1
Non-commissioned officers	19	19
Corporals	10	10
Lance-corporals	13	13
Gunners	74	160
Hospital assistant	1	1
Trumpeters	2	2
	124	210

The Captain of a company of foot artillery, like a Captain of infantry, is mounted, drawing forage for one horse in time of peace, and two in war.

The staff of a battalion of foot artillery is somewhat similar to the staff of an infantry battalion, but if employed independently it has an increased establishment, twenty-five laboratory sergeants-major and sergeants being then attached to it from the staff of the regiment.

The total number of battalions of foot artillery in the German Army is 31, of which 28 are formed into 14 regiments, and 3 are independent. Each Army Corps has one regiment, with the exception of the IXth, XIIIth, and XIVth

[1] An infantry section has 177 of all ranks, with 175 horses and 24 vehicles. An artillery section has 180 of all ranks, with 181 horses and 26 vehicles. Vehicles with small-arm ammunition are painted grey to distinguish them from those with artillery ammunition, which are blue.

[2] In a British Army Corps 162 rounds per infantry rifle would be carried, with 280 rounds for each 16-pr. gun, 298 rounds for each 13-pr. gun, and 300 for each 9-pr.

to which only a battalion is allotted, and the Xth and XIth, which are without this unit.[1]

In time of peace the German foot artillery regiments do garrison duty in the various fortresses; and in time of war are employed either in carrying out siege operations with the Army in the field, or are used to reinforce the garrisons of those fortresses at home which may be regarded as liable to attack.

In an Army Corps when mobilized the units under the command of the artillery commander would thus be 3 batteries of horse artillery, 16 batteries field artillery (114 field guns), 2 columns Divisions (*i.e.*, 10 ammunition columns), with 8 companies of foot artillery if required.

Training of Recruits.—The system of instruction for artillery recruits is similar to that adopted in the cavalry. Each battery of field artillery receives some thirty recruits in the month of November, the complement for a horse artillery battery being somewhat less; and on the 1st April following these men take their places as gunners, and the battery is thoroughly drilled as a unit during the months of April, May, and June. July and the first half of August are devoted to shell practice, after which the battery takes part in the autumn manœuvres, with which the military year terminates.

Although the young men who join each year are classed as recruits until the 1st April, they are drilled along with the old soldiers of the battery for about three months before this date. It is only during the earliest portion of their military career that squads formed exclusively of recruits are to be seen, as it is considered that in order to learn the somewhat complicated duties of a gunner, association with those who have already been trained is of great value.

Recruits intended to act as drivers, though taught to ride, are not allowed to do duty with the battery during their first year's service, the drivers being in all cases furnished by men who are at least in their second year of service.

In order that no delay shall take place when a mobilization is ordered, it is the practice in the German artillery to carry out in every battery a complete mobilization of some indicated portion every year. All the batteries in the regiment then combine the portions they have mobilized, one furnishing a gun complete, one a wagon, one men, another horses, and so on, so that a fully mobilized battery is put together, which is thus annually available for all ranks to study. This battery, as it would stand on war strength, is then sent a short distance by railway for entraining and detraining practice, the whole of the operations being carried out in presence of the Officers, non-commissioned officers, and volunteers belonging to the regiment.

Gun Practice.—Practice with field guns is carried out, as has been mentioned already, in the months of July and August, the number of rounds allotted annually per battery being 244 common shell, 100 shrapnel, and 12 case, or 356 in all. As only 4 guns are available, it follows that each gun which is used fires 89 rounds annually.

The targets are of three sorts, representing skirmishers, formed infantry, and artillery respectively, and fire is opened at various ranges from 1,000 metres to 2,000 metres, or more if the ground allows; but in every case the distance of the target must be estimated, being never known beforehand.

[1] The 2nd Foot Artillery Regiment and the 9th Foot Artillery Battalion as belonging to the Pomeranian and Sleswig-Holstein Corps respectively, are specially trained in coast defence. The 10th Foot Artillery Regiment belongs to the XVth Army Corps. It is formed of a battalion recruited from the territory of the Xth, and another from that of the XIth Army Corps. The 11th Foot Artillery Regiment, which belongs to the IInd Army Corps, is employed in the fortress of Thorn.

V.—Engineers and Railway Troops.[1]

The German engineers are organized in peace time by battalions, styled "pioneer battalions," one of which is, as a rule, attached eo each Army Corps. These pioneer battalions are similar in their composition to the battalions of foot artillery, each consisting of four companies,[2] which have the establishment given below:—

	Peace.	War.
Captain (Hauptmann)	1	1
1st Lieutenant	1	1
2nd Lieutenants	2	3
Sergeant-major (Feldwebel)	1	1
Vice-sergeant-major	1	1
Portepée Fähnrich	1	1
Sergeants	4	4
Non-commissioned officers	10	13
Lance-corporals	9	22
Privates	90	155
Buglers	3	3
Train soldiers	—	11
Assistant Surgeon	—	1
Hospital assistant	1	1
Sutler and assistant	—	2
	124	220

The three first companies of a pioneer battalion are styled field companies, and are trained in pontooning and field work, while the fourth company, being a fortress company and not intended to accompany the field troops, is specially instructed in mining.

On mobilization, the battalion organization disappears, the battalion staff passing at once to the Army Corps staff, and the three field companies being allotted, one to each Division, and the third to the Army Corps.

Bridge Trains.—Three bridge trains are formed from the field companies who have charge of the *matériel* in peace-time, one of these trains being attached to the Army Corps and the others to each of the Divisions. A corps bridge train has the following establishment:—

Captain	1
Lieutenants	2
Assistant Surgeon	1
Paymaster	1
Sergeants-major	2
Sergeants	4
Non-commissioned officers	8
Lance-corporals	7
Musicians	3
Train soldiers	103
Veterinary Surgeon	1
Shoeing smith	1
Total	134

[1] Additional particulars will be found in a paper by Capt. W. H. Hare, R.E., on "The Engineer Arm in Continental Armies," vol. xxix, p. 1159.
[2] The Bavarian companies have five companies each.

An Army Corps bridge train has, moreover, attached permanently from the corps pioneer company a force of 2 Officers and 62 non-commissioned officers and men, with 2 horses, so that the total strength of the bridge train amounts to 198 of all ranks.

Each Divisional bridge train has the following establishment:—

1st Lieutenant	1
2nd Lieutenant	1
Sergeant-major	1
Sergeant	1
Non-commissioned officers	5
Lance-corporals	3
Musicians	2
Train soldiers	40
Total	54

The bridging material, &c., accompanying each of these trains is conveyed as shown below:—

	Divisional.	Corps.	
	1	1	2-horse baggage wagon.
	1	2	4-horse wagons with rack-sides.
	3	—	4-horse tool wagons.
	2	2	6-horse wagons with trestles.
	6	26	6-horse wagons with pontoons and baulks.
	1	2	6-horse wagons with tackle and pontoon appliances.
Total	14	33	vehicles.

The number of horses for a Divisional bridge train is 88, and for a corps train 223, and the lengths of bridge which can be formed by these trains are 36·5 metres and 122 metres respectively. The total length of bridging material which accompanies a German Army Corps amounts, therefore, to 195 metres, or 215 yards.

The fourth or Miner Company in most Army Corps is expanded on mobilization into three fortress companies, *i.e.*, a second miner company and a reserve company, which remain in the Army Corps district unless required to take part in a siege, but in the Guard and in the IVth and VIIth Corps it is the duty of this company to furnish the Field Telegraph Divisions, particulars as to which are given below.

The field pioneer companies, whose war strength has been already mentioned, are accompanied by four wagons, viz., two four-horse wagons (one for tools and one for powder and guncotton), and two two-horse wagons (one baggage wagon and one sutler's wagon).

Field Telegraph Detachments.—Each field telegraph detachment which is formed consists of 4 Officers, 1 Surgeon, 11 employés, and 137[1] men, with 76 horses and 14[2] vehicles. The length of line which can be constructed by a telegraph detachment is 36 kilometres (22 miles), and the appliances for ten stations are also conveyed.

[1] 47 of these men, with 1 Officer, belong to the train.

[2] 6 six-horse telegraph equipment wagons; 2 two-horse office wagons; 3 two-horse officials' wagons; 2 four-horse wagons with rack-sides; 1 two-horse baggage wagon.

Railway Troops.

Railway troops are not a branch of the pioneers in Germany, being under the railway section of the Great General Staff, but from the nature of their duties they are more closely allied to the pioneers than to any other branch of the Service, and it is from this source that most of the railway Officers are obtained.

The railway regiment which exists in time of peace[1] consists of two battalions, each of four companies, but on the outbreak of war this organization disappears, the largest unit then employed being the company. Companies of railway troops in peace-time are employed in various works of construction, and the repair of lines which have been destroyed, as well as in ordinary railway work, but the companies which are formed on mobilization have distinct functions to perform, being classed as construction companies, management companies, and works companies.

It is the duty of a construction company to repair as rapidly as possible the injuries which a retreating enemy may have caused to the railway lines, to lay fresh lines where required, and to render unserviceable any lines which it may be necessary to abandon to the enemy. Companies of this class therefore take the field with troops of the first line, and march among the leading troops. They are formed from the peace establishment of the regiment, and from the reservists and landwehr men who have been trained in its ranks.

Railway management companies are employed to take the place of the civilian officials on a captured line, and are also utilized for working the railway traffic immediately in rear of the field army. A company is considered to be sufficient for the management of a line of railway from 45 to 60 kilometres in length (28 to 37 miles), two or more companies being united under the same inspection. The *personnel* of the railway management companies is mainly obtained from the reserve men of the regiment, with the addition of some Officers, non-commissioned officers, and men from the peace establishment, but all railway employés in Germany who belong to the reserve or landwehr can also be ordered to serve in these companies, irrespective of the arm of the Service in which their colour service was passed, so that it has been calculated that the total number of men available is not less than 20,000.

Railway works companies furnish the *personnel* necessary for the loading and unloading of trains and the storing of goods in the railway depôts.

The establishments of these different companies are as follows:—

	Construction.	Management.	Works.
Captain	1	1	—
1st Lieutenants	2	1	1
2nd Lieutenants	6	4	1
Assistant-Surgeon	1	—	—
Paymaster	1	—	—
Sergeants-major	2	2	3
Sergeants	6	12	3
Non-commissioned officers	17	27	9
Lance-corporals and privates	175	159	186
Train soldiers (Officers' grooms)	11	6	2
Hospital assistants	1	—	—
	223	212	205

[1] It is stated that it is the intention of the German Government to double the strength of the railway troops and form a brigade of 2 regiments.

A construction company has also, when advancing with the Army, a train column attached, consisting of 1 non-commissioned officer and 9 men, with 16 horses and 5 vehicles.[1] When the advance is on a line of railway, a special train for bringing up railway plant is attached to each company.

The four 2nd Lieutenants of a management company would be employed as station masters, while the sergeants and non-commissioned officers would supply the engine-drivers, guards, signalmen, &c., required for the working of the line, the privates acting as porters or cleaners of locomotives and carriages.

VI.—Train and Departments.

Each Army Corps in the German Service includes a train battalion which in time of peace consists of two companies, a depôt and a section of workmen. A bakery section is also attached, and when mobilization is ordered these units are largely increased by the addition of reservists, and are given a very much wider development than might be expected from the peace establishment maintained. The train battalion in peace has only a strength of 12 Officers, 46 non-commissioned officers, 30 lance-corporals, 138 privates, 126 horses, and 24 vehicles, but in time of war it is expanded into the following units, viz., 5 commissariat columns, 5 wagon-park columns, 3 bearer companies, a field bakery train, and in some cases a reserve bakery train, with a depôt of horses.

The establishments of the more important of these units are as follows :—

Commissariat Columns.—Establishment of a commissariat column (Proviant-Colonne) :—

Captain	1
Second Lieutenant	1
Paymaster	1
Veterinary Surgeon	1
Farrier	1
Sergeants-major	2
Sergeants	2
Non-commissioned officers	7
Lance-corporals	16
Musicians	2
Privates (tradesmen)	8
Train soldiers	76
	118

The vehicles in which the commissariat stores are transported are 30 four-horse provision wagons, with 1 four-horse reserve wagon and a six-horse field forge, the total number of horses allotted to a column being 167.

The whole of the wagons for the commissariat columns of the Army Corps, as well as for most of the other formations into which the train battalion is expanded on mobilization, are kept at the train depôt ;[2] and in order that these vehicles may be in thoroughly serviceable condition at any given moment, it is the practice to "mobilize" certain of the wagons every year, in the same

[1] 2 four-horse tool wagons ; 1 four-horse wagon with rack-sides ; 1 two-horse baggage wagon ; 1 two-horse cabriolet.

[2] These depôts are established at the following places : Guard Corps, 1st depôt, Berlin, 2nd, Liebenwalde ; I Corps, Königsberg ; II, Alt Damm, near Stettin ; III, Berlin ; IV, Neustadt, a suburb of Magdeburg ; V, Posen ; VI, Breslau ; VII, Münster ; VIII, Coblenz ; IX, Rendsburg ; X, Hanover ; XI, Cassel ; XII, Dresden ; XIII, Ludwigsburg ; XIV, Carlsruhe ; XV, Strasburg ; ditto, supplementary, Metz ; I Bav., Munich, ditto, supplementary, Ingolstadt ; II Bav., Wurzburg ; 25th Division, Bessungen.

way as portions of each battery of artillery are annually mobilized. These wagons are fully loaded with the stores which they would have to carry on service, and in order that no time may be lost in this work, not only is there on every package which is to be conveyed a label showing the wagon and the part of the wagon where it is to be placed, but in every wagon the list of contents shows also in what storehouse and press the articles are to be found.

Two commissariat columns are attached in time of war to each infantry Division, the fifth column being for the corps artillery and other corps troops, and it is calculated that four days' supplies for the Army Corps can be thus conveyed. During an advance these columns follow the troops to which they are attached, and furnish them with supplies when closely concentrated for action, being also employed for the removal of the sick and wounded. When the Army is stationary the transport of these columns is utilized for bringing up supplies from the nearest railway station or advanced depôt, but it cannot be taken for any other purpose except on the order of the General Commanding the Army Corps.

Wagon-Park Columns.—Besides the commissariat columns there are for each Army Corps the same number of wagon-park columns (Fuhr-Park-Colonnen) and also a sixth column which is for service on the line of communications. The establishment of one of these columns is similar to that of a commissariat column, but there are 105 train soldiers, and the total of all ranks is 142. Each of these columns has 82[1] vehicles and 205 horses, and is intended to convey a six days' supply of forage and flour for the Army Corps, so that counting the 3 days' iron ration which each soldier carries and one day's ration carried in the company wagons, provision is thus made for the conveyance of 8 days' supply for each man, besides flour for 6 days more, and forage for each horse for either 7 or 9 days, according as supplies for 1 or 3 days are carried with the troops. If the wagon-park columns were loaded exclusively with provisions, supplies for 9 days might be sent forward by this means, and if these columns were employed only in conveying forage, the number of days' supply thus carried for the horses of the Army Corps would be 7.

It is to be observed that the wagons required for these columns are not kept in store, but large contractors bind themselves annually to place at the disposal of the Government the required number of covered wagons the instant hostilities may break out. No such arrangements are necessary for the supply of horses, as these are obtained by requisition.

Bearer Companies.—The establishment of a bearer company (Sanitäts Detachment) is as follows:—

Captain	1
First Lieutenant	1
Second Lieutenant	1
Staff Surgeons	2
Assistant Surgeons	5
Field apothecary	1
Paymaster	1
Hospital assistants	8
Sergeants-major	2
Sergeants	5
Non-commissioned officers	12
Lance-corporals	19
Musicians	2
Privates (stretcher bearers)	165
Train soldiers	25
	250

[1] 80 two-horse wagons, and 2 two-horse squadron baggage wagons.

There are in all 45 horses with a bearer company, and 12 wagons,[1] exclusive of a two-horse sutler's wagon which accompanies each of these units.

One of these bearer companies is attached to each infantry Division, the third being at the disposal of the Army Corps Commander, but under ordinary circumstances attached to the corps artillery.

The men who are employed in the bearer companies are specially selected for this duty, a certain number of privates in their second year of service being permitted each year to pass from the line into this branch of the service. The men so selected must be of superior attainments in order that they may profit by the special instruction which is given to them, and none but men of the best character are taken for this employment. Their training includes instruction in finding wounded men, with which object they are practised in discovering some of their comrades who are sent out previously to hide themselves in holes and bushes such as wounded men might crawl into, and they are moreover taught how they can recognize whether an apparently dead man is or is not actually a corpse. The modes of resuscitating those who are thus to all appearance dead are explained, as well as the proper ways to stop bleeding, while carrying the wounded so as to cause them the least amount of pain is practised by making the stretcher bearers march out of step.

Ambulances.—There are several patterns of ambulances used in the German service, the older description carrying 2 men badly wounded, lying down, or 3 men sitting up, with 7 stretchers, and the new pattern, 4 men lying down, 2 men sitting up, and 8 stretchers. With each bearer company there are, therefore, either 56 or 64 stretchers according as the equipment is of the old or new pattern.

Field Bakery Train.—The field bakery train, formed on mobilization in each Army Corps, has a strength of 115 of all ranks, with 15 horses and 2 vehicles.[2] This train is composed of two sections, the men in one section being exclusively bakers, while those in the other are butchers, cattle-drivers, masons for the construction of ovens, &c. Travelling ovens are not supplied to Army Corps bakery trains, but two such vehicles form part of the equipment of a reserve bakery train, of which units there is one for each separate Army. The Army Corps bakery trains do not follow the corps closely; being generally left at some convenient spot, and moved as seldom as possible.

Horse Depôts.—Horse depôts are maintained to make good casualties without delay, and consist of 115 of all ranks, with 201 horses and 2 baggage wagons.

Army Departments.

In the German Army the branches of the Service which we know by the name of the Departments of the Army are the Commissariat, the Medical Department, the Veterinary Department, the Legal Department, the Postal Department, and the Chaplain's Department.

Commissariat.—The commissariat (Intendantur) consists of two classes of Officers, viz., the administrative Officers who are attached to the Staff of Divisions or Army Corps, and the executive Officers who belong to the commissariat and wagon-park columns.

The duties of this Department are divided into four branches, viz., accounts; subsistence; clothing; garrison and hospital administration. Under the first of these branches are included the paymasters who are doing duty with the various corps, and who relieve the company commanders and others in analogous positions of all trouble with regard to the men's accounts.

[1] 8 two-horse ambulances, 2 two-horse pharmacy wagons, and 2 two-horse baggage wagons.

[2] A four-horse bakery equipment wagon and a four-horse reserve wagon.

The subsistence branch attends to the contracts for provisions and forage, and the proper maintenance of the stock of rations required for the Army on mobilization, while the clothing branch controls the action of the regimental clothing committees,[1] and the remaining branch concerns itself with hospitals and barracks.

The Corps Intendant is in some respects directly responsible to the War Minister, and is thus partially independent of the General Commanding the Army Corps; but this independence has much less practical effect under the purely military administration of the German War Office than in countries where the War Minister and his subordinates are civil functionaries.

Medical Department.—The Medical Department has also a certain number of administrative Officers who serve on the Staff of Army Corps and Divisions, while the great bulk of the *personnel* of this branch of the service is employed directly with the troops. The numbers of those thus employed have been given with the staffs of the various regiments, &c., but in addition to these a very large proportion of the medical profession in Germany is in time of war required for service in the field hospitals.

Field Hospitals.—These hospitals are each calculated for the reception of 200 patients, and have the following establishment:—

Surgeons	5[2]
Field apothecary	1
Hospital inspector	1
Accountant	1
Hospital assistants	9
Non-commissioned officers	5[3]
Hospital orderlies	12
Cook	1
Trumpeter	1
Train soldiers	19
	55

With a field hospital there are 32 horses and 6 vehicles,[4] the Surgeons being all mounted.

For each Army Corps there are 12 such field hospitals, and these draw their equipment on mobilization from the train battalion of the corps. In addition to these, however, there is established in time of war a hospital reserve depôt for each army in the field, and from this depôt the field hospitals draw supplies of hospital stores as may be required, and replace casualties which may occur in the *personnel*.

The line of communications (Etappen) hospitals have an establishment of about three times the strength of a field hospital,[5] but have no horses or vehicles. The Surgeons, however, are allowed train soldiers to act as grooms for their private horses.

The German Medical Department is supplied with Officers partly from those who have been trained at the military medical institutions with the object of joining the Department, and partly from those young men who intend to practise afterwards as civil physicians or surgeons, and who fulfil their military obligations in this capacity.

Veterinary Department.—The Veterinary Department is represented by the

[1] See page 352.

[2] 1 Surgeon-major, 1 Surgeon, and 3 Assistant Surgeons.

[3] 2 of these belong to the train.

[4] 3 four-horse utensil wagons; 2 two-horse ambulances, and 1 two-horse baggage wagon.

[5] Each of these hospitals has 19 Surgeons.

Veterinary Surgeons who are attached either to the Staff of the Army Corps, or to the various regimental units. Candidates for this branch of the Service have usually been educated at the Army Veterinary School in Berlin.

Legal Department.—The Legal Department consists entirely of the auditors attached to the Staff, two of these officials being allotted to each infantry Division, and one of superior grade to each Army Corps. They have duties to perform which are somewhat analogous to those of a Judge Advocate in our Service, but these duties include taking part in the preliminary investigation, by which a decision is arrived at, whether the case should or should not be sent for trial.

Postal Department.—The Postal Department is a small one, but it has been organized with quite as much care as those branches which are of more direct importance to the well-being of the troops. To each Division and to the corps artillery is attached in time of war a section consisting of 5 postal officials, 13 men, 12 horses, and 2 two-horse wagons, and to each Army Corps a somewhat larger section, viz., 4 officials, 17 men, 19 horses, and 4 two-horse wagons. These postal sections do not exist in peace-time as part of the normal organization of the German Army, but in each large garrison there is a military post office for the transmission of official correspondence which would otherwise be sent by orderlies. To this little post office, which is established in a central position, each corps sends an orderly once a day with the outgoing letters, and the same orderly brings back any letters which are addressed to his corps, this military post office thus resembling a bank clearing house. The business of the office is managed by two lance-corporals who are relieved every three months, so that without drawing on the resources of the Imperial Post Office, the Army has always available a number of soldiers who are trained in the work of sorting and dispatching correspondence. When on service the field post office forwards both official and private correspondence as well as post-cards, newspapers, and money orders.

Chaplain's Department.—Chaplains are attached to infantry Divisions in the proportion of two to each, and one of the corps artillery, making a total of five for each Army Corps. They belong to the Lutheran Church, but in the case of twelve Divisions which are territorially associated with districts where the prevailing religion is the Roman Catholic, an additional chaplain of this denomination is appointed.

VII.—Recruiting.

In Germany every man is liable to military or naval service, and cannot free himself from this liability either by purchasing exemption or by providing a substitute. To this rule exceptions are made only in the case of members of reigning houses, and in time of peace in favour of the sole supporters of families, or of parents who are incapable of work. As has been mentioned in an earlier part of this paper, the liability to military service commences at 17 years of age, but as a rule men are not required to join the Army till they are in their 21st year. As the number of young men in the German Empire who annually attain the age of 20 years is calculated to be over 400,000, while the contingent fixed for the Army is only 151,000 exclusive of volunteers, it is plain that this rule of furnishing personal military service to the State affects considerably less than half of the community in time of peace. Those, however, who are thus exempted are not the most desirable recruits, as the men who are to serve in the ranks are not selected till all those who are physically unfit, or undersized, have been eliminated. The number of men who are absolutely unfit to be made use of in any military capacity is comparatively small, and of those who appear unfit or undersized in their 20th year, many are found suitable a year or two later.

One per cent. of the population is taken as the basis of calculation for the strength of the Army in peace-time, and this is maintained very accurately, as the population of the German Empire in 1884 was ascertained to be 45,234,000, while the establishment of the Army for 1885–86 amounts to 457,705 of all ranks.

The number of recruits who are to join each unit is annually fixed by an Imperial Decree, the numbers at present standing as follows :—

For the Guards and 7 specified infantry regiments of the line	225 per battalion.
For all other infantry and rifles	190 „
For each cavalry regiment at least	150 per regiment.
For each horse artillery battery at least	25 per battery.
For each field battery at least	30 „
For the foot artillery regiments Nos. 8 and 10	200 per battalion.
For all other foot artillery regiments	160 „
For the railway troops at least	135 „
For each train company for three years' active service	15 per company.
For each train company for half year's service	44 „

The following table, the figures of which relate to the year 1883, will explain the manner in which the recruiting operations are carried on :—

Age.	Morally unfit.	Physically unfit.	Passed to Ersatz Reserve.	Taken for service in the ranks.	Total.	Volunteers.
20 years	307	35,666	14,036	66,102	116,111	13,955
21 „	298	11,772	9,503	37,114	58,687	2,336
22 „	289	17,613	124,402	36,888	179,192	1,535
Above 22 years.	458	3,424	4,118	1,713	9,713	2,479
Total	1,352	68,475	152,059	141,817	363,703	20,305
Percentage	0·4	18·8	41·8	39·0	90·9	5·1

In addition to those who are included in this table, there were in the year 1883, 15,877 young men who had emigrated without permission and thus escaped being drawn for military service.

Those who are held to be morally unfit to serve their country are men who have been sentenced to confinement in a house of correction, and whose offences are of such a nature that it is hopeless to expect that they will turn out reformed characters. Those, however, who at the time when they should be brought forward to take part in the drawing, are undergoing imprisonment of more than forty-two days, or who have been deprived of their civil rights, are not thereby exempted, but are classed among those who are temporarily unfit, and are brought up again a year later with those whose defect was physical rather than moral.

A man is not considered to be physically unfit unless he is maimed or so deformed as to be evidently incapable of employment in any military capacity as long as he lives. The subsidiary services of the Army are so varied that the number of men who are thus judged incapable of serving is not very large, as in such capacities men may be usefully employed who could not be allowed to take their places in the ranks.

In deciding on the fitness of a man to serve in the ranks the conditions first

looked to are chest measurement and height. No one is accepted whose chest measurement is below 80 cm. (32 in.) while the minimum heights of recruits for the different branches of the service are as follows :—

Guards: 170 cm. (5 ft. 7 in.) one half to be 175 cm. (5 ft. 9 in.) and in exceptional cases men of 167 cm. (5 ft. 6¾ in.) are taken.
Infantry, rifles, and train 157 cm. (5 ft. 2 in.).
Cuirassiers, lancers, and foot artillery, 167 cm. (5 ft. 6¾ in.).
Dragoons, hussars, field artillery, pioneers, and railway troops, 162 cm. (5 ft. 4 in.). In exceptional cases men of 157 cm. (5 ft. 2 in.) may be taken for dragoons and hussars.

In certain branches of the Service there is also a maximum standard of height. Thus recruits for the rifles, cuirassiers, lancers, train, and horse artillery must not exceed 175 cm. (5 ft. 9 in.) while the limit for dragoons and hussars is 172 cm. (5 ft. 7¾ in.).

The minimum limit of 157 cm. (5 ft. 2 in.) for infantry may appear low to us, considering that the minimum limit for our infantry is 5 ft. 4 in., and we are disposed to regard one of our line regiments as decidedly undersized if it has in its ranks many men under 5 ft. 6 in., but it is to be noted that the minimum height for recruits is higher in Germany than in any other Continental army.[1]

Men in Germany who are below the prescribed standard of height, but who do not appear to have yet reached their full stature, are put back as being temporarily unfit, and have to present themselves again when they are a year older. If by that time they have grown sufficiently, they are admitted to the lot drawing, but if still undersized they are put back for another year, when if suitable they are accepted, but if unsuitable they are passed into the Ersatz Reserve, and are not called on to join the standing army.

Men may be passed into the Ersatz Reserve the first, second, or third time that they present themselves, but as may be seen by the table on page 305, the great majority are retained as temporarily unfit until they are 22 years of age, not being sent to the Ersatz Reserve till it is absolutely certain that they cannot be made available for the active army.

In the same way men who at 20 years of age claim exemption by reason of being the sole supporters of their family, &c., are not permanently excused on proving this to be the case, but must present themselves each year till they are 22 and show to the satisfaction of the Recruiting Commission that their circumstances have not altered in the meanwhile.

The Ersatz Reserve, which receives all the young men who from any of these causes are not taken into the active army, keeps their names on its lists till they have completed their 31st year, and during this time they are liable in case of war to be called on to fill vacancies in the ranks of the active army, thus taking the places of men of their own age. This Ersatz Reserve is, however, divided into two classes, into either of which a man may be passed according to his physical fitness for military service. Those who are best suited for taking their place in the ranks, but who have not been drawn for the active army, either by reason of being below the minimum height, or because they obtained a high number in the lot drawing, are placed in the first class, while those who are less eligible form the second class. Neither of these classes received any military training whatever in former years, but in 1880 authority was obtained from Parliament for the calling out of a portion of the first class, so that in the event of war, when these men would be required for service, they might not be absolutely ignorant of military duties. The number of the first class to be thus trained was calculated on

[1] Austria, 5 ft. 1½ in.; France, 5 ft. 0¼ in.; Italy, 5 ft. 1¼ in.; Russia, 5 ft. 0¼ in.

the basis of the requirements of the army on mobilization being supplied by five annual contingents, and as this is taken at about 100,000 the number annually called up for training since 1881, when this system was commenced, has been about 20,000.[1] The total number of men who join the first class annually is, however, about 60,000, so that two-thirds of this class remain without any military instruction. Those who are called up have to attend for a period not exceeding ten weeks for their first training, four weeks in their second year, and a fortnight in each of the two succeeding years.

Under ordinary circumstances a man who has been passed into the first class of the Ersatz Reserve remains in it for five years and then joins the second class till he completes his 31st year, but in the case of those who have been trained as mentioned above, there is no transfer to the second class, these men remaining in the first class, and consequently liable to immediate military service, up to the date when they cease to belong to the Ersatz Reserve. The number of partially trained men therefore which may eventually be obtained from this reserve will amount to considerably over 150,000. Men of the first class of the Ersatz Reserve are called up for training in the following order: those are first taken who have drawn high numbers, and then the remainder in proportion to their fitness for military service. On completing his 31st year a man passes into the landsturm till he is 42 years of age, when his military liability finally ceases.

Ersatz Commissions.—In Germany the recruiting business is managed by what are called Ersatz Commissions. For each regiment of infantry (other than the Guards, who are recruited throughout the Empire) there is a recruiting district, and this district is divided into two landwehr battalion districts, which are in their turn divided into four company districts.[2] An Ersatz Commission to deal with the recruiting business is assembled every year in each of the 275 landwehr battalion districts, and is composed of the commander of the landwehr battalion, an administrative official, some civilian members, and an infantry Officer.

This Commission meets in the early part of each year, and all the young men in the district who become liable to military service during the current year have to appear before it. They are examined medically, and any men who claim exemption, or who are desirous of postponing their service, lay before the Commission the grounds on which their application is based. All simple cases are there and then decided, but any points which the Commission considers to be beyond its powers are referred to the Ober-Ersatz Commission, of which there is one for each infantry brigade district.

The Ersatz Commission having heard the various petitions, and having decided what men shall be put back for a year on account of want of height, &c., and what men shall be drafted at once into the Ersatz Reserve, proceeds to assign to each of the remaining young men his place on the district recruiting list. This is done by lot drawing, the requisite number of recruits being eventually taken from those who draw the lowest numbers.

In order that no young man shall escape coming before the Ersatz Commission, this body is supplied each year with an extract from the register of births, showing the names of those within the district who have become liable to military service since the last return; and all who have become domiciled within the district, or who may be living in it without being domiciled, are bound to report themselves to the Commission on attaining the military age. Any young man who neglects to report himself, or who fails to present himself before the Commission when required, forfeits his right to draw lots,

[1] In 1881 nearly 40,000 were called up, but in 1882 and 1883 the number was 21,000, and in 1884, 18,000.

[2] Particulars as to the landwehr battalion districts will be found in No. 457, "Revue Militaire de l'Étranger," May 1879.

and is in the end, unless he quits the country, drawn for service before all other conscripts.

Ober-Ersatz Commission.—The Ober-Ersatz Commission, which, as has been stated, decides matters which are beyond the competence of the ordinary Ersatz Commissions, has for its president the infantry brigade commander, the members of this Commission being an administrative official and a civilian, with a Field Officer of the Guard who is attached with the special object of looking after the recruiting for the Guard Corps.

The number of these Ober-Ersatz Commissions corresponds to the number of infantry brigades, exclusive of the Guard, and is consequently seventy-one, while the number of ordinary Ersatz Commissions is about four times as many.[1]

The Ober-Ersatz Commissions assemble every year in the summer, and visit each of the districts in which the ordinary Ersatz Commissions have held their sittings in the earlier part of the year. All young men who have not been put back by the ordinary Commission must then appear again, and after a further medical examination, and a consideration of the cases left to their decision, the Ober-Ersatz Commission proceeds to levy recruits according to the requirements of the service, taking care to select a certain number of supernumeraries in order to be prepared for casualties.

In levying recruits for the Army the young men are selected in the following order :—Those who have neglected to enrol their names, or failed to appear on a former occasion, are first taken; then those who in the previous year drew low numbers but from any cause were not taken ; then those who draw lots in the current year, in the order of their drawing. If the numbers thus available are insufficient, the Ersatz authorities can draw on some young men whom they have retained at disposal from previous years, and if these should still leave the number below the contingent required from the district, recourse is had to the supplementary district, of which there is one for each Army Corps, to make up the deficiency.

Any appeal from the ruling of the Ober-Ersatz Commission is decided by the Army Corps Court, which is composed of the General Commanding the Army Corps, and a civil functionary, and the final appeal rests with the Minister of War of the State in which the recruiting district is situated.

The men who are thus selected for service by the Ober-Ersatz Commissions are sent to their homes, on furlough, and handed over to the landwehr authorities until they are required to join in the autumn. Before they are sent to join their corps the commander of the landwehr battalion district satisfies himself that each recruit is supplied with a good and sufficient stock of wearing apparel ; and where the man is not so supplied, and is too poor to obtain the necessary clothing for himself, it is furnished by the civil authorites, and the cost paid by the parish or district to which the man belongs, if his relations are unable to meet the expense.

Volunteers.

In the German Army there are two classes of volunteers, viz., three-years and one-year, and any young man who has reached the age of 17 years may, with the consent of his parents or guardians, apply to enter the Army as a volunteer of one or other of these classes.

Three-Years Volunteers.—Those who volunteer for three years apply to the civil president of the Ersatz Commission of their district, and on proving that they are of blameless character and free from all civil ties they may be accepted as candidates. The advantages which a young man gains by

[1] As special arrangements are adopted for recruiting in Alsace and Loraine, the numbers do not correspond exactly.

volunteering for three years are that he can begin his service if it suits him two or three years before the normal age, and that he can select the particular arm and regiment in which he wishes to serve. For the cavalry the period of service for volunteers is four years instead of three, but in consideration of the extra year so passed in the ranks, their time of service in the landwehr is reduced by two years.

In the infantry of the line the number of three-years volunteers annually received must not exceed ten per company or forty per battalion, and if there is no vacancy in the corps for which a young man volunteers, his name is put down for it, and he is sent on furlough until a vacancy occurs. In the cavalry and rifles, however, there is no restriction to the number of this class of volunteers, and the Commanding Officer may take as many volunteers as he chooses, provided he does not go beyond the peace establishment laid down. As the three-years volunteer while in the ranks differs in no respect from any other soldier who is fulfilling his obligation to serve the State for a like period, this class of volunteers is really only a class of soldiers who have entered the service by voluntary enlistment instead of by conscription.

One-Year Volunteers.—The one-year volunteer on the other hand stands in a totally different position. He is essentially a supernumerary, and in consideration of having only one year's service in the ranks, he has to pay the whole of his own expenses, and costs nothing to the State. For a young man to enter the Army as a one-year volunteer he must apply when he is between the ages of 17 and 20, and in addition to the consent of his parents or guardians, and a certificate of irreproachable conduct, he must produce a certificate of intellectual attainments from certain specified schools or colleges, or failing this must pass an examination which will prove him to be possessed of a corresponding amount of knowledge.

The number of one-year volunteers who can be received is limited to four per company of infantry, and three per battery of artillery, but the number admissible into a squadron of cavalry is not fixed. Commanders of squadrons, however, are not as a rule desirous of having many one-year volunteers under their orders, as they have already a large proportion of the four-years volunteers, and it is not always certain that a young man can be turned into a creditable trooper in a year.

While a three-years volunteer can enter on his service before the normal age of 20 years, if it suits his convenience, the one-year volunteer has the additional privilege of postponing the date of his entry into the Service till his 23rd year, if he wishes from any reason to delay the commencement of his military service. Of course a young man cannot thus postpone his entry unless when he is 20 years of age he has satisfied the Ersatz Commission as to his fitness to be received as a one-year volunteer, and he must at the same time have selected the capacity in which he proposes to serve. It is by no means obligatory on a one-year volunteer to serve exclusively as a combatant, as in the event of his being a medical or veterinary student he may be employed while in the Army as a Surgeon or Veterinary Surgeon, but it is in all cases required of him that he should pass six months of his time in the ranks as a soldier.

The one-year volunteer in time of peace costs the State nothing. He has to supply himself with clothing from the regimental stores on payment of its value, and for the use of the necessary articles of equipment he is charged at a fixed rate. If mounted, the horse he rides is his own property and must be kept at his own expense, while everything spent on his own maintenance must come out of his own pocket. The sum ordinarily required amounts to about 105*l*. a year, but if from any cause a one-year volunteer, in the course of his year's service, finds himself unable any longer to pay his expenses, he may cease to be a volunteer and can become an ordinary soldier. Each month

which he has passed as a volunteer is then credited to him as three months ordinary service, and the time which he has to serve in the ranks to complete his time with the colours is calculated on this basis.

A one-year volunteer, after his twelve months are ended, passes into the reserve, having been given a certificate of qualification for the rank of Officer or non-commissioned officer, if while serving he has shown himself fitted to be something better than a private. When he obtains the certificate of Officer, he does not at once become a reserve Officer, but ranks only as a non-commissioned officer, and during the year following that in which he served with the colours, he must do duty as such, usually in his old corps. If after four weeks' duty as a non-commissioned officer he is considered by the commander fit to be an Officer, he is employed in this capacity for four weeks more, and if he passes this test satisfactorily he returns home and is eventually gazetted as a reserve Officer. When a one-year volunteer is desirous of being not merely classed a reserve Officer, but enrolled as a reserve Officer of the particular regiment in which he served, the examination as to his fitness is very stringent; as the Officers of the regiment take good care that a man who may thus join them for service in the field shall be thoroughly competent to take his place as their comrade. It should be observed that the fitness of any man to be a reserve Officer is determined not merely by his military attainments but also by his social qualifications, and that no one is accepted who is not considered satisfactory by the Officers of the landwehr battalion of his district.

The period of service in the reserve is the same for a one-year volunteer as for anyone else, viz., four years, after which he passes in the usual course into the landwehr and landsturm.

VIII.—Mobilization.

Before explaining the steps by which the German Army is mobilized, it will be as well to set down clearly what is meant by this term. No army can be maintained at all times in a state of complete readiness for war, as the expense of permanently keeping up such quantities of draught animals, &c., as are necessary to make a modern army "mobile," would be beyond the resources of any nation. Moreover, as for garrison duty in time of peace a comparatively small force is required, while for modern warfare, at all events in countries where railways exist, armies cannot be too large, it follows that on passing from a peace to a war footing there must be a very great and very rapid expansion of the military force, which must necessarily involve such considerations as the clothing, arming, equipment, and general organization of the men thus added to the existing army, before the whole can be regarded as an efficient fighting machine. In this country, we have had no experience of mobilization. We have on various occasions called out our Reserves, but the wars in which they have been employed have been of a very different character from the life and death struggle to which the mobilization of a Continental Army is usually the prelude. How we should fare if required to carry out a real mobilization in the face of an imminent invasion is a question which it is not easy to answer satisfactorily, and therefore in speaking of mobilization as an abstract operation, we must simply regard the steps which must be taken by any Continental Power to prepare itself for a great war. These steps may be conveniently considered under two heads, viz.: those necessary for rendering the army of the first line ready for immediate service, and those necessary for creating troops of the second and third lines, and for defending the mother country.

To render the army of the first line fit to take the field, the cadres which exist in time of peace must be brought up to the war establishment, and certain new units must be formed. This involves the assembly of the reserve

men, who are living at home engaged in civil pursuits, arranging for sending them to join their corps, as well as clothing, equipping, and arming them on arrival.

Secondly, there is the formation of the staffs necessary for the army which is to take the field, as well as the large administrative staff required ; and

Thirdly, the army has to be supplied with horses.

In considering how far Germany is prepared to carry out these operations, the most important point to be observed is that each of the Army Corps of which her army consists is an absolutely independent unit, whose commander, on receipt of the orders to mobilize, can act without further reference to Berlin. By this system of decentralization whatever operations are required can go on simultaneously in each of the Army Corps districts, and the Army Headquarters in Berlin are left free for the transaction of more important business, confident that by a certain date the mobilization of every corps will be complete.

Completion of Cadres.—Turning now to the completion of the cadres from the reserves, which has been mentioned as the first step taken on the receipt of the mobilization orders, it is to be observed that in this respect Germany is advantageously situated. Her population is homogeneous, and tolerably evenly distributed, so that in each Army Corps district, the reserve men are at no very great distance from the centre at which they must report themselves. These centres are usually the headquarters of the landwehr district, but if it is considered that these places would become unduly crowded, the Army Corps Commander appoints additional rendezvous, which are notified to the Officers concerned. In all cases, however, the necessary arrangements are completed in time of peace, and as little as possible is left to be done under the strain and hurry of the mobilization. Thus the landwehr battalion commander has ready in case of need the *calling out* orders addressed to each individual reservist and landwehr man within the district, so that, on inserting the date, these orders specifying where the man is to report himself can at once be dispatched. Within twenty-four hours from the time when this order is received the man must be at the appointed rendezvous.

Before the men arrive at the rendezvous, however, each regiment sends a detachment[1] to this centre to receive the reservists, and pass them on by batches to the regimental headquarters. Here arms are kept in store for the regiment on a war footing, and from these stores the reservists are supplied, being afterwards furnished with clothing from the regimental clothing stores, in which perfectly new uniforms for the unit on war strength are always kept up.

The reservists who join each regiment or other unit are furnished from those who formerly served in its ranks, connection in peace-time being maintained by the rule, that all men while in the reserve are liable to be called out for two trainings of eight weeks each, these periods of training being passed with their old regiments at the time of the autumn manœuvres.

Comparing the peace and war strengths of the different units, it will be seen that the numbers which they have to receive on mobilization are as follows :—

Company of infantry	1	Officer	114	men.
Squadron of cavalry	—	„	24	„
Battery of field artillery	1	„	72	„
Company of foot artillery	1	„	86	„
„ pioneers	2	„	94	„
„ railway troops	6		104	„

It will be noticed that the cavalry in Germany are much more rapidly

[1] Usually 1 Officer, 1 Surgeon, and 6 non-commissioned officers.

prepared for war than any other branch of the Service. By forming the fifth squadron into a depôt, they can take the field four squadrons strong at very short notice; as the 96 men and 122 horses necessary to bring the four squadrons up to war strength might be supplied from the fifth squadron without waiting for the arrival of any reserve men. This, however, is not done under ordinary circumstances, it being considered sufficient that the cavalry should be ready to march on the third day of the mobilization.

Appointment of Staffs.—The second point which has been mentioned as a step in the mobilization of an army is the appointment of the staff. In Germany this is not left till war is imminent, but for every post which would have to be filled up on mobilization there is at all times an Officer nominated, so that when the occasion arises he at once steps into the place for which he has been selected, the duties of which have been perhaps for years the subject of his careful study.

It is needless to say that this does not apply to the staff of an Army Corps, Division, or brigade which is mobilized, as it is part of the system of the German Army that the staff of such units shall be composed in time of peace exclusively of those men who are best fitted to serve in the same capacities in time of war. Army Corps and Divisions, therefore, on mobilization take the field with exactly the same staff, with certain additions, which they have in peace, and at such a critical time as the outbreak of war there is no sudden or violent change in the system on which business is conducted.

Representative Administrations.—The departure, however, of the Army Corps with its entire staff would give rise to inconvenience in the transaction of business connected with the depôt and other troops remaining in the Army Corps district, and it is therefore provided that on mobilization the ordinary staff shall be at once replaced by what are called representative administrations. In each corps these are as follows:—

The Corps Commander with Staff,
4 Infantry Brigade Commanders,
The Inspector of Depôt Squadrons,
The Commander of the Artillery,
The Provincial Intendance with its branches.

The Officers who are to fill these various posts are all selected beforehand, and they commence work during the period of mobilization in order to become acquainted with their duties, but they do not exercise their functions actively till the Army Corps has moved off to the seat of war.

The staffs of such large units as Armies or cavalry Divisions which have no existence in time of peace must of course be assembled at the outbreak of war, but as the number and composition of the Armies which would be formed is dependent on the character of the enemy against whom hostilities are to be undertaken, and as the possible enemies of Germany are very few in number, the appointment of the staffs for the various cases is not a very complicated matter, and under any circumstances which may arise a complete staff is at all times ready for immediate service.

If the Officers selected for such duties are already holding commands or staff appointments, others hold dormant commissions to fill the posts which may thus be vacated, the Officers so chosen being generally taken from the half-pay or retired lists.

Supply of Horses.—The third point noted above is the supply of horses to the Army, and the steps necessary for carrying this out proceed simultaneously with the assembly of the men and the formation of the staffs. In order to form an idea of the magnitude of the operations involved in supplying the Army with horses to the extent required for service in the field, it may be mentioned that while in time of peace the number of horses maintained in

the Army is 96,000, the number required for war, supposing the whole of the military forces of the Empire to be mobilized, would amount to over 350,000, so that some 260,000 animals would have to be obtained. Of these, however, all would not be required at once on the outbreak of war, but even when those which can thus be dispensed with temporarily have been deducted, at least 150,000 must be found to meet the immediate necessities of the field troops. These horses are obtained by requisition, every animal in each district being enrolled and classed according as it is fit for riding or draught, and from these lists, which are revised every sixth year, the owners are summoned to send their animals to certain appointed centres for purchase by the military authorities. At each of these centres there is a Receiving Commission composed of one or two Officers, a veterinary surgeon, and some clerks,[1] and the horses presented are examined, and if considered suitable are purchased at a price determined by a Valuing Commission. As soon as the purchase is completed, the horses become the property of the State, and are handed over to the regimental escort parties who are waiting to receive them, as each regiment has assigned to it a definite centre where it is to obtain its horses in case of mobilization.

The numbers which the different units require to raise them from the peace to the war establishment are as follows :—

Infantry battalion	33
Cavalry regiment	122
Battery of horse artillery	154
Field battery	106
Company of foot artillery	6
Company of pioneers	18
Company of railway troops	28

The horse artillery is the arm which it is considered most important to supply with horses at the earliest date, so that it may accompany the cavalry Divisions to the front, and in case of necessity it is provided that these batteries should be supplied with horses from the field batteries of the same regiment, which have their deficiencies made good when the requisitioned horses begin to arrive. For the troops of the first line, it is considered that the necessary horses will arrive on the fifth day, and that within two days of their arrival they will be ready for any duty.

As improvements in the system are eagerly sought for, it is highly probable that on the next occasion on which the German Army is mobilized a considerable gain in rapidity will be noticeable; but as a proof of the excellence which was attained sixteen years ago, the following results of the mobilization of 1870 are interesting :—

Infantry of the line	were	ready on the	8th	day.
„ Guard	„	„	10th	„
Cavalry	„	„	3rd	„
Horse artillery	„	„	3rd	„
Field artillery	„	„	8th	„
Pioneers	„	„	8th	„
Train (1st Section[2])	„	„	10th	„
„ (2nd Section[3])	„	„	18th	„

The staff and military police, &c., were ready on the 8th day.

[1] These Receiving Commissions are detailed annually by the Corps Commander.

[2] Viz., 2 commissariat columns, 2 bearer companies, 4 field hospitals, and 1 bakery train for each Army Corps.

[3] Viz., wagon-park columns and etappen columns.

In most cases the mobilization was very much facilitated by the circumstance that regiments drew both their reserve men and their horses from the district in which they were quartered, but in certain instances both had to join from a distance, and this must happen again to some extent unless, before the next German mobilization, Alsace and Lorraine have become thoroughly assimilated to the rest of the Empire. The great pressure on the railways, however, does not begin till after the corps are fully mobilized, when the strategic movement of the army to the theatre of war is commenced, and during the early days of the mobilization it would be quite possible for reserve men to move from one end of Germany to the other in nearly the same time that would be required for the journey under ordinary circumstances.

Strategic Concentration.—As soon as each Army Corps is fully prepared, it is sent forward to the theatre of war; by route march if the distance is short, and by train if it is more remote. Germany being well supplied with railways and rolling stock, there is at least one line of railway available for the conveyance of each corps in any given direction, and the strategic concentration of her armies can thus be carried out with the utmost regularity. The lines of railway which are used for the conveyance of the fighting units in the first instance serve afterwards for the supply of the corps, and the removal of its sick and wounded, a convenient station within the Army Corps district being established as a military traffic centre, to and from which all military trains proceed.

Having considered the steps necessary for placing the first line army in the field, we may turn to the other steps necessary for a general mobilization, viz., the formation of reserve and depôt troops, and the armament of the fortresses.

Reserve Troops.—The term reserve troops includes the landwehr, the reserve rifle companies, reserve cavalry regiments, the reserve batteries, and, where they are not required with the Army Corps, the foot artillery regiments and pioneer companies. These troops, as a rule, are employed to garrison fortresses, to defend the line of communications, and to keep order within the Empire, but if necessary they can be pushed forward to reinforce the field army.

Landwehr.—The landwehr, as has been mentioned already, is a territorial force, in some respects resembling our militia, but composed exclusively of men who have already served in the ranks of the Army, and who are on the average about thirty years old. In time of peace only small cadres are kept up, and these are exclusively for the infantry,[1] but in time of war, units of cavalry, artillery, pioneers, and train are formed as well as infantry.

There are generally seventeen landwehr battalion districts for each German Army Corps, two such districts corresponding to each infantry regiment in the corps, and one district being in reserve. In the case of the large towns of Berlin, Breslau, and Cologne, these form reserve landwehr regiment districts, Berlin furnishing 4 battalions, and the others 2 each. The total number of landwehr battalions which could be thus raised would amount to 280, to which, however, must be added 18 battalions for the 9 regiments of Guard infantry, which have no recruiting districts, and two more for the 109th Baden Grenadiers, which is likewise without a district, so that the total number of landwehr battalions available would amount to 300.

There are two establishments for a landwehr battalion on war strength,

[1] At landwehr battalion headquarters, 1 Field Officer in command, 1 Lieutenant attached from the corresponding infantry regiment, 1 clerk, and 2 orderlies. In each company district there is also a district sergeant-major, a non-commissioned officer, and a private: total, 2 Officers and 15 men.

viz., 22 Officers and 802 men, and 22 Officers and 1,002 men; the latter being adopted when the magnitude of the struggle in which the country is engaged renders it necessary.

Fourth Battalions.—There is a further reserve of infantry for which no cadres are maintained, and of which no mention is made by the Germans, but which is recognized by French critics as likely to have a very real existence in the next war in which Germany is engaged. This force consists of the fourth battalions, which it is assumed would be raised in some or all regiments as soon a mobilization is ordered, and the grounds on which this assumption is based are as follows:—As the number of recruits which each infantry battalion receives annually is 190, the number received by the regiment is 570, and at any time there are 12 contingents available, viz., 3 in the ranks, 4 in reserve, and 5 in the landwehr. The total number would thus be 570 × 12 or 6,840, or, allowing for the normal decrease, 6,143. If from these only 3 battalions of the first line (at 1,026 each) and 2 battalions of landwehr (at 824 each) were formed, there would remain 1,417 thoroughly trained soldiers still available. It is known that it is the intention to fill up the depôt battalions, which will presently be mentioned, to a considerable extent with men of the Ersatz Reserve, and as it is not likely that such a large body of trained soldiers would be left unemployed, it is considered that they would be formed into fourth battalions. If each regiment, however, were to raise a fourth battalion of the usual strength, the surplus remaining out of the twelve contingents would only be 391, and this would leave such a very small margin that it is considered probable that each regiment will only raise a half battalion. This view is supported by the fact that each regiment has in reserve clothing and equipment for two companies (see page 327), and there would therefore be no difficulty in the formation of these half battalions, whose number is calculated at 140,[1] thus furnishing, if necessary, 23 additional regiments of three battalions each.

Reserve Rifle Companies.—In addition to the landwehr infantry of the line there are reserve rifle companies to the number of one for each rifle battalion. These reserve rifle companies have no existence in time of peace, but the clothing and equipment necessary for them are kept at the headquarters of the battalion. When required for service the men are obtained from the reservists or landwehr men who formerly served in the rifle battalion, and should it be considered desirable to form them into reserve rifle battalions, four of the companies are combined for this purpose.

Reserve Cavalry Regiments.—It has been already mentioned that the fifth squadron of a German cavalry regiment becomes the depôt on mobilization, and in connection with every such depôt squadron one or two reserve squadrons are formed from the reservists and landwehr men who are available after the service squadrons have been brought up to war strength. Clothing, equipment, and saddlery for these squadrons are kept with the regiment in time of peace, and are issued by the depôt squadron on mobilization. The reserve squadrons, when organized, are formed into reserve cavalry regiments, each of four squadrons, and as the normal number of line cavalry regiments in an Army Corps district is five, it may be assumed that the number of reserve squadrons will be from eight to ten, and that on the average two reserve regiments will be formed in each Army Corps district.

Reserve Batteries.—The corps artillery regiment in each Army Corps forms on mobilization three or four reserve batteries, which constitute the Divisional artillery of the reserve Divisions. The *matériel* necessary for these batteries

[1] As the Guards mobilize a double force of landwehr, it would not be possible for them to form fourth battalions.

is kept in time of peace at the headquarters of the artillery regiment, and is identical with that of ordinary field batteries. The men are obtained from the reserve and landwehr, Officers and non-commissioned officers being to some extent supplied from the depôt batteries or detachments.

Reserve Pioneers.—Reserve pioneers are formed in a similar manner on mobilization in the proportion of a reserve company to each pioneer battalion, the miner company having the duty of forming this unit.

Reserve Train.—A train, in its general organization resembling that of the regular troops, is also attached to each reserve infantry Division (see page 350).

Depôt and Garrison Troops.—The whole of the units of the landwehr may be employed in guarding the lines of communication of the field army, in holding entrenched camps within the frontiers of the home country, or in occupying captured fortresses in the enemy's territory, so that to provide for the filling up of the vacancies which occur in ranks of the field troops, recourse must be had to the special formations known as depôt and garrison troops. The rule adopted is that when any unit of the field army is more than 5 per cent. below its establishment, a requisition is sent to the depôt, and as an instance of the extent to which the depôts were drawn on during the war with France, it may be mentioned that up to the beginning of March, 1871, 2,172 Officers, 222,590 men, and 22,012 horses were supplied to the field army from these sources.

Infantry Depôts.—Depôts are formed on mobilization in every branch of the service, that for a regiment of infantry consisting of a battalion with a normal strength of four companies. The depôt battalion of each regiment of the Guards has, however, five companies, and in the line whenever a depôt battalion has a strength of more than 300 men above the four company establishment, these supernumeraries are formed into a fifth company.

The Officers required for these depôt battalions are furnished partly from the corresponding regiment of the active army, and partly from reserve and landwehr Officers. In 1870–71 on the average there were 7·7 Officers from the active army in each depôt battalion, and 6·5 Officers of reserve and landwehr, the remainder of the Officers' posts in the battalion being filled by non-commissioned officers.

A depôt battalion of the line with four companies would have the following establishment:—

Officers	Battalion staff	2
	Company	16
	In charge of tradesmen	1
Non-commissioned officers and men	Non-commissioned officers and recruits	1,004[1]
	Tradesmen's section	211[2]
Medical Officers		2
Paymasters		2
Armourers		1
		1,239

The recruits are obtained by calling up men on furlough, Ersatz Reserve men, and men of the landwehr, as the needs of the Service may require, and any annual contingents which may become available during the continuance of the war would of course join the depôts for instruction before being sent on to the units in the field. At the commencement of the war with France, the first casualties in the German Army, occurring during August and Sep-

[1] 400 of these are drawn from the 1st class of the Ersatz Reserve.
[2] 11 non-commissioned officers, 100 tailors, and 100 shoemakers.

tember, 1870, were replaced by thoroughly trained soldiers, of whom there were about 500 in each battalion, and the men next sent forward consisted of volunteers and Ersatz Reserve men, incorporated at the time when the mobilization of the Army was ordered. These sufficed to meet the requirements of the field troops up to the beginning of 1871, when the young men forming the contingent of 1871 who had joined during the previous autumn began to be available.

Garrison Battalions.—In every brigade district a special battalion is formed on mobilization, which is called a garrison battalion, and consists of four companies. The function of this battalion is to act as a depôt for the corresponding landwehr regiment, in the same way as the depôt battalion serves for its regiment in the first line. These garrison battalions have an effective of 22 Officers, 2 Surgeons, 1 Paymaster, 1 armourer, and 1,006 non-commissioned officers and men, the Officers being mainly drawn from the landwehr, and the men being furnished almost exclusively from the Ersatz Reserve. The Guard landwehr regiments, for which no garrison battalions are raised, draw their recruits from the 5th companies of their depôt battalions, which are maintained for this special purpose.

Depôt Squadrons.—The squadron of a cavalry regiment left behind as a depôt, on mobilization has the following establishment:—

Officers	5
Non-commissioned officers and men	201
Medical Officers	1
Paymasters	2
Veterinary surgeons	1
	210

with 212 horses. In any Army Corps district where the number of cavalry reserve men is more than sufficient to meet the requirements of the cavalry and of the train, one or more dismounted or garrison squadrons are formed, but these would probably in the course of the war either be supplied with horses and used as cavalry, or employed at the depôts of horses which would be formed within the district.

Artillery Depôts.—Each regiment of field artillery forms on mobilization a depôt detachment, consisting of a staff, two batteries of six guns each, and a tradesmen's section. The detachment formed by the Divisional regiment of each corps has two depôt field batteries, but the detachment formed by the corps artillery regiment has one depôt field battery and one depôt horse artillery battery.

The establishments of these are as follow:—

	Field battery (divisional regiment.)	Field battery (corps art. regiment.)	H. A. battery.
Officers	4	4	4
Non-commissioned officers and men	165	215	139
Horses	68	68	118

The foot artillery regiments form on mobilization thirty-one landwehr battalions, corresponding to the thirty-one Guard and line battalions constituting

this force, and for each mobilized foot artillery battalion a park company is organized. The landwehr battalions serve as depôts to their corresponding battalions of the first line, and have approximately the same establishment.

Pioneer Depôts.—Each battalion of pioneers forms a depôt company on mobilization, with a tradesmen's section attached. The company has a strength of 4 Officers and 262 non-commissioned officers and men, with a Surgeon, an hospital assistant, and 2 Paymasters, while the tradesmens' section is composed of 5 non-commissioned officers and 70 men.

Railway Troops Depôt.—The railway regiment forms on mobilization a depôt detachment of two companies, with an artizans' section, the depôt detachment having a strength of 16 Officers and 410 non-commissioned officers and men, with a surgeon, 2 hospital assistants, and 3 Paymasters, and the artizans' section, 1 Officer and 106 non-commissioned officers and men.

Train Depôts.—Each of the eighteen train battalions forms on mobilization a depôt detachment, consisting of a staff, two companies, and a train depôt, with a tradesmen's section. The detachment has a strength of 12 Officers, 502 non-commissioned officers and men, with 9 non-combatants, 211 horses, and 40 vehicles, and the tradesmen's section, 1 Officer and 127 non-commissioned officers and men.

Horse Depôts.—In each Army Corps district a stationary depôt of horses, to the number of 300, is formed to receive the animals obtained by purchase or requisition, to forward them to the movable horse depôts which follow the field army, and to provide for unforeseen casualties. Two central horse depôts are also provided, each for 500 horses, so that if these depôts are maintained at their full establishment a reserve of over 6,000 horses would always be available in Germany, exclusive of the animals which might be obtained in the immediate neighbourhood of the operations.

Arming of the Fortresses.—With regard to the remaining step in the mobilization of the German Army, viz., the arming of the fortresses, it is only necessary to observe that the points of attack having all been very carefully considered in peace-time, the proper measures of defence are promptly adopted, and in those fortresses which are on the frontier or otherwise liable to early investment, special precautions are taken that the troops forming their garrisons shall receive their reserve men at the earliest moment, so that there shall be no risk of their being shut out by the advance of the enemy. In all fortresses there is an extensive network of subterranean telegraphic communication, both with the rest of the Empire and between the various portions of the defensive system. For each detached work a Commander is nominated in time of peace, and all details of the garrison required, the supply of provisions, ammunition, and stores, have been most carefully worked out, the principle in this, as in all else connected with the German mobilization, being, that so far as is possible, everything which can occur is foreseen, and that nothing which can be settled beforehand is left to be decided in the hurry of imminent war.

The following are the most important of the German fortresses :—

On the side of the Netherlands, Belgium, and France :

Wesel, Cologne,[1] Coblenz, Mayence, Metz,[1] Germersheim, Rastatt, and Strasburg.[1]

On the side of Switzerland and Austria :

Ulm, Ingolstadt,[1] Neisse, and Glogau.

On the side of Russia :

Posen,[1] Thorn,[1] Königsberg,[1] and Danzig.

In the interior of the Empire are Magdeburg, Custrin, and Spandau, and on the Baltic and North Sea there are numerous fortified harbours, of which the most important are Kiel, Friederichsort, and Wilhelmshaven.

[1] Surrounded by a girdle of detached forts.

IX.—The Army on a War Footing.

In the previous section the steps have been mentioned by which the units of the German Army are raised from peace to war strength, and it now remains to consider the Army as it might stand when completely ready for action. It has been seen that the principles which are observed in fitting the Army for active service are, that as little as possible is left to be done when war is imminent, and that, as far as can be, that organization is preserved under which the troops have been serving in time of peace.

The Brigade.—The increase which takes place in the establishment of regiments involves no alteration in their organization, and in the next larger unit, the brigade, the changes only affect the cavalry. Troops as a rule take the field as part of the same brigade to which they belong in time of peace, and continue to serve under the same Brigade Commander, who is assisted by the same Staff Officer.

Infantry Brigade.—An infantry brigade consists ordinarily of two infantry regiments, and though in time of peace some brigades have three regiments, it may be considered that two is the normal establishment which would be maintained in time of war. An infantry brigade on war strength would therefore stand as follows :—

	Generals.	Officers.	Men.	Horses.	Wagons.
Staff............	1	1	10	14	1
2 Regiments	..	158	6,224	270	56
Total...............	1	159	6,234	284	57
	6,394 of all ranks.				

The six battalions of which the brigade consists would furnish 6,144 combatants, of whom 5,856 would be armed with rifles, for each of which 112 rounds are carried.

Cavalry Brigade.—The number of regiments in a cavalry brigade in time of peace varies from two to four, but it may be assumed that in time of war all cavalry brigades would have the normal establishment of two regiments; the extra regiments which would thus become available being attached to the various infantry Divisions as Divisional cavalry.

A cavalry brigade would thus stand as follows when on war strength :—

	Generals.	Officers.	Men.	Horses.	Wagons.
Staff...............	1	1	10	14	1
2 Regiments	..	56	1,312	1,472	16
Total..............	1	57	1,322	1,486	17
	1,380 of all ranks.				

The eight squadrons of which the brigade is composed would furnish 1,253 mounted combatants, of whom 1,056 would be armed with carbines, for each of which 50 rounds of ammunition is carried.

Infantry Division.—An infantry Division when on war strength varies from the peace establishment both in the increased size of the units composing it, and in the new formations which are called into existence on mobilization; but in its general organization it is merely a development of what has existed in peace-time, and is in no respect a new formation. It takes the field with its own commander and its own staff, and the troops comprising it are exclusively those which are permanently associated with it, and between whom there is a bond of union.

Its war strength would be as follows :—

	Generals.	Officers.	Men.	Horses.	Wagons.
Staff	1	29	71	79	10
2 Infantry brigades........	2	318	12,468	568	114
1 Cavalry regiment.........	..	28	656	736	8
1 Field artillery detachment	..	25	696	618	75
1 Pioneer company	..	6	214	19	4
1 Divisional bridge train...	..	2	52	88	14
1 Bearer company	..	12	240	47	13
Total....................	3	420	14,397	2,155	238
	14,280 of all ranks.				

The 12 battalions of infantry, 4 squadrons of cavalry, and 4 batteries of artillery composing the Division would furnish 12,292 infantry combatants, 624 cavalry combatants, and 24 guns. As mentioned already there is no Divisional ammunition column, and therefore the number of rounds per rifle is the same as that which under ordinary circumstances is carried with a battalion, but in the event of a Division being employed independently, one of the corps ammunition columns would be specially detailed to accompany it.

Cavalry Division.—The cavalry Division being an organization which, except in four instances, does not exist in Germany in time of peace, these units have to be formed as soon as a mobilization is ordered. Although this departure from the custom prevailing in the other branches of the service might seem less suited to the prompt employment of cavalry on the outbreak of war than the Russian plan by which all regular cavalry regiments are permanently united into cavalry Divisions, yet the Germans doubtless consider that with their admirable railway communications they can assemble their cavalry wherever it may be required, in a sufficiently short space of time, and regard whatever drawbacks there may be in their system as more than counterbalanced by the advantages of maintaining thoroughly the principle of localization.

Cavalry Divisions were employed independently in advance of each of the German Armies in the invasion of France in 1870,[1] and it is from the experience of that war, that the normal composition of a German cavalry Division on war strength must be deduced. It would therefore in all probability stand as follows :—

[1] When the war commenced, the 3rd Cavalry Division (16 squadrons and 1 battery) covered the advance of the 1st Army; the 5th, and 6th Cavalry Divisions (56 squadrons and 3 batteries) covered the advance of the 2nd Army, and the 4th Cavalry Division (24 squadrons and 2 batteries) covered the advance of the 3rd Army.

	Generals.	Officers.	Men.	Horses.	Wagons.
Staff	1	28	71	79	10
3 Cavalry brigades (24 squadrons)	3	171	3,966	4,458	51
1 Horse artillery division (3 batteries)	..	20	505	708	57
2 Ammunition wagons	..	—	7	13	2
Total	4	219	4,549	5,258	120
	4,772 of all ranks.				

The 24 squadrons of cavalry and 3 batteries of horse artillery which form the fighting strength of a German cavalry Division would furnish respectively 3,754 mounted combatants and 18 guns, 50 rounds per carbine being carried by each man, with 10 additional rounds in the ammunition wagons.

In case of a cavalry Divison being employed independently it might be accompanied by a mounted bearer detachment furnished from the Army Corps which are in rear, but otherwise must be entirely dependent on the regimental surgeons and hospital assistants for whatever medical or surgical aid may be required.

As the destruction of railways is a very important part of the duty of a cavalry Division covering the advance of an invading army, each squadron is supplied with a set of light tools specially adapted to this object, while two spare sets and two similar sets of heavy tools for more serious demolitions are carried as a reserve.

The Army Corps.—The Army Corps, which is the largest unit existing in time of peace, receives on mobilization a considerable development, but as in the Division, the changes which are made do not affect its general organization.

The Army Corps when on war strength would stand as follows :—

	Generals.	Officers.	Men.	Horses.	Wagons.
Headquarters Staff	2	48	224	252	20
2 Infantry Divisions	6	840	28,794	4,310	476
1 Rifle battalion	..	25	1,031	40	12
Corps artillery	..	54	1,393	1,250	151
10 Ammunition columns	..	38	1,782	1,818	256
1 Pioneer company	..	6	214	19	4
1 Corps bridge train	..	7	191	225	33
Train battalion (forming 5 commissariat and 5 wagon park columns, the field bakery, horse depôt, 12 field hospitals, and a bearer company)	..	149	2,330	2,551	664
Total	8	1,167	35,959	10,445	1,616
	37,134 of all ranks.				

The 25 infantry battalions, 8 squadrons of cavalry, and 16 batteries of artillery in an Army Corps give a fighting strength of 25,620 infantry combatants, 1,248 cavalry combatants, and 96 guns. For each infantry rifle there are 172 cartridges provided, and for each cavalry carbine 74, while 256 rounds are carried for each field battery gun, and 288 for each horse artillery gun. There are the means of carrying 8 days' food for each man in the Army Corps, forage for 7 days for all riding, and 9 days for all draught horses.

With regard to the medical establishment of an Army Corps, there is one surgeon to every 203 men of the gross total and one to every 150 of the fighting strength, while the medical assistants, men of the bearer companies, &c., are in the proportion of 1 to every 28 men of the gross total, and 1 to every 20 men of the fighting establishment.

From what has been stated above it will have been seen how carefully the requirements of an Army Corps for service in Europe have been provided for, and all will recognize the merits of the system by which the German Army Corps can be sent on active service under its own Commander, with no more trouble than is required for the despatch of the battalion, cavalry regiment, or battery, which are the largest units to which the orders of our Commander-in-Chief are ordinarily conveyed.

The Army.—It has been already mentioned that the German Army has eighteen Army Corps similar in composition, with one independent infantry Division (the Hessian), and these corps are in time of war combined to form Armies. The strength of an Army varies according to the circumstances of the campaign, but it may be taken as a rule to be composed of from two to four Army Corps.[1] The staff of an army is naturally dependent on the number of Army Corps of which it consists, and is therefore not laid down, being assembled only when war is inevitable, but those who are to occupy important posts are designated for them beforehand, and by the time the mobilization of the various Army Corps is complete, the superior directing staff is certain to be in working order.

At the head of all, controlling the Commanders of the different Armies, is the Sovereign, with the Great General Staff, established either at Berlin or at some advanced station, as the progress of the campaign may render desirable.

Such is the German Army of the first line, which would have the following total available war strength :—

Generals.	Officers.	Men.	Horses.	Wagons.
223	26,900	794 000	254,500	32,400
821,123 of all ranks.				

Taken according to the arms of the Service there would be 503 battalions of infantry, 203 companies of engineers and foot artillery, 465 squadrons of cavalry, and 340 batteries of artillery.

Before considering the army of the second line, to which the duty of home defence would presumably be confided, the organization of the line of com-

[1] In 1866 two armies were formed, the first consisting of three corps and the second of four. In 1870 the campaign was commenced with three armies, of which the first had two corps, the second four, and the third four, with two independent Divisions.

munications must be taken into account, as the troops required for this service may be furnished either from those of the first line or from those of the second.

Etappen Inspections.—For each separate army which is constituted in time of war an etappen inspection is formed, and this department has the duty of forwarding to each Army Corps in the field the supplies of all kinds which the military authorities in the corresponding Army Corps district wish to send to the front, while it at the same time relieves the corps of all sick, wounded, and prisoners whose presence would tend to impair its efficiency.

Each etappen inspection has the following establishment :—

1 Lieut.-General (Etappen Inspector) with 6 train soldiers, 10 horses, and one 4-horse wagon.

1 Staff Officer with 4 train soldiers, 8 horses, and one 4-horse wagon.

3 Adjutants[1] with 3 train soldiers and 6 horses.

1 Paymaster, with 1 man and 1 horse.

1 Senior veterinary surgeon with 1 man and 1 horse.

2 Veterinary surgeons with 2 horses.

5 Mounted orderlies with 5 horses.

13 Dismounted orderlies.

4 Non-commissioned officers as clerks.

3 Farriers.

The other branches of the etappen inspection are as follows :—

Military Police : 1 Captain, 1 sergeant-major, a number of privates varying with the strength of the army,[2] 4 train soldiers, with 6 horses and a 2-horse wagon.

Intendance : 24 officials, 42 men, 54 horses, and 7 wagons (three 4-horse, four 2-horse).

Medical : 1 Surgeon-Major, 1 assistant surgeon, 4 men, 5 horses, and a 2-horse wagon.

Legal : 1 etappen auditor, with 1 clerk, 2 men, 2 horses, and a 2-horse wagon.

Telegraph Service : 1 etappen Telegraph Director, with 3 Inspectors, 8 men, 10 horses, and four 2-horse wagons.

Postal Service : 1 Army Postal Director, with 3 Inspectors, 6 men, and 8 horses.

Civil Administration : 1 senior civilian official, with 1 police official, 3 men, 4 horses, and a 2-horse wagon.

The etappen inspection for each army thus consists of at least 178 men, 122 horses, and 17 wagons, and all such inspections are controlled by the Inspector-General of the Etappen, who is in direct communication with the Great General Staff. The Staff of the Inspector-General of Etappen amounts in all to 104 men, with 108 horses, and 15 wagons, and includes representatives of the legal department, the intendance, the medical, the telegraph and the postal services, as well as a special staff for field railway work.

Second Line Troops.—The troops of the second line are furnished by the landwehr as already explained (page 305), and these are organized in a manner similar to that adopted by the first line, except that there is no unit of reserve troops larger than the Division.

Reserve Infantry Brigade.—The landwehr battalions for which cadres are maintained in time of peace are formed on mobilization into landwehr regiments of three battalions each, and two such regiments constitute a reserve brigade, the establishment of which will be as follows :—

[1] A Captain of artillery, a Captain of engineers, and a Lieutenant.

[2] In the proportion of 20 for each Army Corps of which the army consists.

	Generals.	Officers.	Men.	Horses.	Wagons.
Staff	1	1	10	14	1
2 Regiments	..	156	5,002	268	56
Total	1	157	5,012	282	57
	5,170 of all ranks.				

The 6 battalions of which the brigade consists would furnish 4,954 combatants, of whom 4,664 would be armed with rifles.

The number of landwehr infantry brigades which could be formed in each Army Corps district amounts as a rule to three,[1] but as each district would presumably only mobilize one reserve Division, a considerable force of landwehr infantry would remain to be disposed of, and these troops, amounting to eighty-three battalions, would be available for employment wherever they might be most required.

Reserve Infantry Division.—A reserve infantry Division has a composition generally similar to that of a Division of the first line; with the addition of certain units which there form part of the Army Corps establishment. Its war strength is as follows:—

	Generals.	Officers.	Men.	Horses.	Wagons.
Staff	1	29	71	79	10
2 Reserve infantry brigades	2	314	10,024	564	114
1 Reserve cavalry regiment	..	28	656	736	8
1 Reserve field artillery detachment[2]	..	20	526	468	55
1 Reserve pioneer company	..	6	214	19	4
2 Reserve infantry ammunition columns	..	6	348	350	48
1 Reserve artillery ammunition column	..	7	189	197	28
1 Reserve bearer company	..	12	240	47	13
3 Reserve field hospitals	..	24	144	96	18
2 Reserve commissariat columns	..	6	230	334	64
Total	3	452	12,642	2,890	362
	13,097 of all ranks.				

The twelve battalions of which the reserve infantry Division consists may be increased, if considered desirable, by a reserve rifle battalion formed as already mentioned from the reserve rifle companies which are raised on mobilization, but as this additional battalion is not a necessary part of the infantry Division it has not been included above. The total fighting strength of a reserve infantry Division would thus be 12 battalions, or

[1] The IXth, Xth, XIIIth, and XIVth Army Corps districts furnish rather less.
[2] 3 batteries, but in some cases 4.

9,912 infantry combatants; 4 squadrons or 624 mounted combatants, and 3 or 4 batteries of artillery (18 or 24 guns) with the small force of pioneers.

For each Army Corps of the first line there would be a reserve Division constituted as here shown, and in addition there would remain for disposal a considerable force of landwehr of all arms, being the surplus after the formation of the eighteen reserve Divisions. The numbers of the landwehr troops, considered under these two heads, would be as follows:—

	Generals.	Officers.	Men.	Horses.	Wagons.
18 Reserve infantry Divisions..........	54	8,136	227,718	52,020	6,516
Surplus	..	6,147	207,645	11,025	2,538
Total	54	14,283	435,363	63,045	9,054

Third Line Troops.—The German troops of the third line consist of the landsturm, but as the men of this category have never yet been called out, the strength of the military force which might thus be supplied must remain a matter of conjecture. The total number of men liable for service as members of the landsturm is, however, very large, being no less than 3,634,210 in the year 1880, but if only those are considered who have passed through the ranks of the regular army and the landwehr, and who are still fit for service, the number of such men thoroughly trained, and not exceeding 42 years of age, is estimated at 965,000, from which at a very moderate computation 300 regiments of infantry and 100 regiments of cavalry might be formed.

The numbers of the troops mentioned above as comprising the force which Germany could put in the field, if it were requisite to employ the whole of her military resources, would be approximately as follows:—

1st line troops	821,120	of all ranks.
2nd ,, ...	449,700	,,
3rd ,, (landsturm)............................	965,000	,,
Total........	2,235,820	

To these, however, must be added the strength of the depôt and garrison trooops already referred to, and these would stand as follows:—

Infantry	161 depôt battalions	199,479	of all ranks.
	66 garrison battalions	67,496	,,
	20 depôt rifle companies	5,140	,,
Cavalry,	93 depôt squadrons..............................	19,530	,,
Artillery	74 depôt batteries	13,367	,,
	31 foot landwehr battalions	19,809	,,
Pioneers,	42 depôt and fortress companies....	8,652	,,
Train,	18 train detachments	9,252	,,
		342,725	,,

thus making a total of 2,578,545 of all ranks.

If we put on one side the landsturm, and consider only the available resources of the Empire in men between the ages of 20 and 32, it becomes interesting to note what proportion the total of 1,613,535 who compose the German Army on a war footing bears to the number of those who have been

actually trained as soldiers. Counting men in the ranks and those belonging to the reserve and the landwehr, 12 annual contingents will be available, *i.e.*, 12 × 150,000 or 1,800,000, less an allowance for the normal decrease. The average decrease has been calculated to be 5·4 per cent., and after making this deduction it appears that 1,702,800 thoroughly trained men will be available. But in addition to these men the German Government can draw on the Ersatz Reserve, and though the bulk of these men have had no military instruction, the number of those partially trained, under the system introduced in 1881, already amounts to about 100,000, and is increasing every year. The maximum will not be reached till 1893, but after that date the German Government will be able to count on obtaining from this source at least 200,000 men with some military knowledge.

Thus it appears that without counting the untrained men of the 1st class of the Ersatz Reserve, who must number nearly 200,000 more, the system in force in Germany will provide 1,900,000 trained men to fill up the cadres of an army which on war strength amounts to something over 1,600,000. The further reserves of men which might be drawn on in case of a great national emergency are the 2nd class of the Ersatz Reserve and the landsturm.

X.—Clothing, Equipment, and Arms.

Before entering on any description of the clothing of the German soldier, it may be as well to remark briefly on the system by which clothing and equipment are supplied. In Germany there is no great central clothing department, but everything connected with the supply of uniform is left absolutely in the hands of the regimental Officers. In each regiment, the Colonel is held responsible that his men are properly clothed and equipped, but the machinery by which this result is obtained is a Board of Officers who attend to the details. This Clothing Board (*Bekleidung's Kommission*) is generally appointed annually, and consists of five members, viz., a Field Officer as President, a Captain, two Lieutenants, and a Paymaster. In infantry regiments there is also a Battalion Clothing Board in each battalion, consisting of a Captain as President, and a Lieutenant and the Paymaster as members. These Boards receive the money allowance granted to the unit, and with the approval of the regimental commander enter into contracts for the purchase of materials, and arrange for the making-up of the uniforms in the regimental workshops. The money allowance has been calculated with extreme nicety, so that the most rigid economy is necessary to bring the cost of the articles produced within the grant, and leave a balance to be added to the clothing fund; but from the fact that the headquarters of a regiment are always established at the same place, contracts can be obtained on favourable terms, and the materials are made up by the tradesmen attached to the regiment, and, if extra hands are required, by the wives of the non-commissioned officers, who are paid at a low rate.

The clothing when completed is put in store, there being rooms provided for this purpose, for each company, squadron, battalion, or regiment.

The company or squadron store contains ordinarily three complete suits for every man of the peace establishment, viz., the war uniform (*krieg's-garnitur*) which is only issued on mobilization, the parade uniform (*parade-garnitur*) which is worn on State occasions, and the Sunday uniform (*Sonntag's-garnitur*) in which the troops appear on Sundays and at inspections.

The battalion store, or the corresponding store for each artillery division, contains a complete outfit of clothing and equipment for every man required to raise the unit from the peace to the war establishment.

The regimental store consists of four branches, viz., (1) the regimental depôt store, (2) the landwehr regiment store, (3) the landwehr depôt store, and (4) the reserve store.

(1) The regimental depôt store contains complete stores for the depôt battalion (or other corresponding formation) which is raised on mobilization.

(2) The landwehr regiment store has similar stores for the landwehr battalions, &c., when called up.

(3) The landwehr depôt store is in the same way calculated for the requirements of the landwehr depôt battalion, or garrison battalion.

(4) The reserve store is for the purpose of meeting unforeseen demands, and contains all that is necessary for two companies on war strength.

The number of outfits which are thus permanently maintained in each German infantry regiment are sufficient for $7\frac{1}{2}$ battalions on war strength,[1] and if we add the four or five suits which are kept for each man on the peace establishment, we arrive at a total of from 10,000 to 12,000 uniforms in possession of each regiment.

Infantry.—The following are the articles of clothing and equipment of a German infantry soldier for service in the field.[2]

Clothing.—1 forage cap with cockade, 1 tunic, 1 neckcloth, 1 pair cloth trousers, 1 pair linen trousers, 1 pair drawers, 1 great-coat, 1 pair cloth ear flaps, 1 pair boots, 1 pair shoes, 1 pair half-soles, 2 shirts.

Equipment.—1 helmet, 1 knapsack and straps, 1 waist-belt and plate, 1 great-coat strap, 1 havresack, 1 flask, 1 sword-knot, 2 cartridge pouches, 1 rifle-sling, 1 box of spare parts for rifle, 1 grease-box, 1 canteen and straps, 1 bag to hold rice, 1 bag for coffee, 1 bag for salt.

Miscellaneous Articles.—1 bag containing bandages (carried in the trousers pocket), 1 mark of identity, and in some cases a small coffee-mill, of which 52 per battalion are carried distributed among the men.

The mark of identity is a small tin label worn round the neck, and stamped with the number of the man's regiment, squadron, or company, as well as with his own regimental number.

Tools.—The tools which are carried with a battalion are as follows:—

Carried by the men:—400 small spades.
40 pickaxes.
20 hatchets.

Carried in the wagons:— 54 large spades.
18 mattocks.
12 axes.
27 hatchets.

Regimental Distinctions.—The distinctive characteristics in the uniforms of infantry regiments are to be found in the colours of the lace, the facings, and shoulder-straps, and in the numbers or initials on the shoulder-straps.

It was formerly possible to ascertain by the colour of the shoulder-straps the Army Corps to which a man belonged, certain colours having been adopted by certain corps, but since the formation of the XVth Corps there have been a considerable number of transfers of regiments, which have retained their old colours on their shoulder-straps, and it is not always possible to identify troops by this mark.[3]

Most regiments have their number on the shoulder-straps, but it may be as well to observe that the only regiments whose shoulder-straps are without

[1] 3 active, 1 depôt, 2 landwehr, 1 garrison, and ½ in reserve.

[2] Additional particulars as to value and time of wear will be found in No. 503 of the "Revue Militaire de l'Étranger," May, 1880.

[3] The colours of the shoulder-straps were as follows: Ist and IInd Corps, white; IIIrd and IVth, bright red; Vth and VIth, yellow; VIIth and VIIIth, blue. The series of colours being recommenced with the IXth and Xth Corps. Corps with uneven numbers were further distinguished by a white piping to the facings.

either a number or the cipher of their honorary Colonel, are the four regiments of Prussian Foot Guards and the Guard Fusilier regiment.

The men of each battalion have a different coloured acorn on the sword-knot; this being white for 1st battalions, red for 2nd, and yellow for 3rd.[1] Men of the different companies are further distinguished by the colour of the crown and of the slide on the sword-knot, which are white for the 1st company, red for the 2nd, yellow for the 3rd, and blue for the 4th. The companies of a German regiment being numbered throughout the battalions from 1 to 12, these numbers are marked on the button of the shoulder-strap, so that it is always easy to recognize to what company a man belongs.

Depôt troops have the same dress and accoutrements as the corresponding field troops, and the only difference between the men of the landwehr and the line is that the former wear on the front of their helmets or forage caps the plain white cross, known as the landwehr cross.

The tunic worn by the German infantry is single-breasted, of dark-blue cloth, except in Bavaria, where light-blue is worn, with red collar, piping, and cuffs; the trousers are dark-blue with red piping (light-blue in Bavaria), and on the march are generally worn inside the long boots. The helmet (*pickelhaube*) is made of black leather with a peak both before and behind, decorated with an eagle in front and a cockade on the right side. This cockade is of the national colours of the State from which the regiment originates, and is black and white for Prussia, white and light-blue for Bavaria, black and red for Wurtemberg, and so on, each minor State or Principality having its own combination of colours. In Bavaria the metal spike on top of the helmet is replaced by a black woollen plume extending from the back to the top, from which this head-dress is called a *Raupen-helm*.

Riflemen wear dark-green tunics with red facings, and have grey trousers with red piping, the head-dress being a shako with a plume, instead of the helmet.

All German infantry wear a grey great-coat, which, when not in use, is carried in a roll extending diagonally across the body over the left shoulder.

Distinctive Marks of Rank.—It will be convenient before considering the arms of the German infantry soldier to mention the distinguishing marks of the various ranks. These are as follows:—

Non-commissioned Officers.—Lance-corporals wear a button embossed with an eagle on each side of the collar of the tunic. Non-commissioned officers of whatever grade have either silver or gold lace on the collar and cuffs, according as the buttons of the tunic are of white metal or brass, and generally wear a sword-knot of the national colours. Sergeants and sergeants-major have in addition a large eagle button on the collar of the tunic, sergeants-major being distinguished by their wearing an Officer's sword.

Portepée Fähnrichs wear Officers' sword-knots and cockades, but are in all other respects dressed like sergeants-major, except that they have no eagle button on the collar.

Company Officers.—All infantry Officers wear a silver sash, and in the field Second Lieutenants may be known by plain silver shoulder-cords, with the number of their regiment on them in gold, while First Lieutenants and Captains wear the same with the addition of one gold star for the former, and two gold stars for the latter. For full dress, epaulettes are worn bearing stars similar to those just mentioned as indications of rank.

Field Officers.—Field Officers have twisted silver shoulder-cords with the number of the regiment, a Major having no star, a Lieutenant-Colonel one, and a Colonel two, exactly as in the junior ranks. The epaulettes which Field Officers wear in full dress differ from those of company Officers in having bullion fringes, but the distinctions of rank are similarly shown.

[1] Fourth battalions (formed on mobilization) have a blue acorn.

Medical Officers.—Medical Officers wear shoulder-cords carrying stars to indicate their relative rank, but their shoulder-cords have silk worked in, and rest on a blue or red velvet ground. They are further distinguished from combatant Officers by wearing on the shoulder-cord a peculiar badge—the rod of Æsculapius—and in action have always a white band with the Geneva cross on the upper part of the left arm. This band is worn by all members of the bearer companies, including the train soldiers employed as drivers, but the regimental stretcher-bearers previously referred to are distinguished by a red band, worn also on the left arm, but without a Geneva cross on it.

Paymasters.—Paymasters are distinguished by wearing on the shoulder-cords a coat of arms, and by their facings being generally dark-blue, with white buttons and helmet ornaments.

Volunteers.—One-year volunteers wear a twist of worsted of their national colours round the shoulder-straps, but are in other respects dressed as privates. Three-year volunteers have no distinguishing mark.

Generals.—General Officers wear blue tunics with red facings, the twisted shoulder-cords which they wear in the field being made of two strands of gold cord and one of silver. On these the rank badges are fixed in the usual way; a Major-General having no star, a Lieutenant-General one, and a General two. They wear silver epaulettes in full dress, with corresponding rank badges, the head-dress being a helmet with gold mountings and a black and white feather plume for parade, and their trousers having a broad red stripe.

Staff.—Officers of the General Staff have a dress similar to that of General Officers, but with crimson facings and double trouser-stripes, the lace and buttons being silver. Their helmet has silver mountings and a white horse-hair plume for parade, and all Staff Officers, with the exception of the Chief of the Staff of an Army Corps, are further distinguished by wearing the sash over the right shoulder.

Adjutants.—Adjutants wear their regimental uniform, but carry the sash over the right shoulder instead of round the waist.

Intendance.—Officers of the Intendance Department wear shoulder-cords of blue silk and silver lace twisted together; their tunics being blue with crimson facings, and their helmets ornamented with silver mountings.

Legal.—Auditors wear a uniform similar to that of Officers of the Intendance Department, but with red facings instead of crimson.

Chaplains.—Military chaplains wear the ordinary dress of their profession, with the addition of a band of violet silk with a white stripe on each side, worn on the upper part of the left arm.

Infantry Arms.—The German infantry are armed with the Mauser rifle, model 1871; a central-fire breech-loading arm of which the following are the principal data:—

Length without bayonet	4 ft. 5 in.
" with bayonet	5 ft. 11½ in.
Diameter of bore	0·435 in.
Number of grooves	4
Twist	1 turn in 50 calibres.
Weight without bayonet	9 lbs. 9 oz.
" with bayonet	11 lbs. 3¼ oz.
Charge of powder	77 grains.
Weight of bullet	382·4 grains.
Weight of cartridge complete	648 grains.

The Mauser rifle is sighted up to 1,600 metres, and with an elevation of 35° has an extreme range of about 3,000 metres.

The bayonet adopted for the German infantry is a sword-bayonet of which 10 per cent. are furnished with a saw back. Those non-commissioned officers

who do not carry rifles are armed with swords similar to those worn by Officers.

Weight carried.—The total weight carried by a German soldier, including his arms and 80 rounds of ammunition, is nearly 70 lbs., without counting the weight of the entrenching tool or the coffee-mill which may form an addition to his load.

Infantry Officers wear a small black leather knapsack when on active service, but their great-coats and baggage are conveyed in the company wagons.[1]

Cavalry.—The following are the articles of clothing and equipment of a German cavalry soldier for service in the field :—

Clothing.—1 forage cap with cockade, 1 tunic, 1 linen jacket, 1 neckcloth, 1 pair trousers strapped with leather, 1 pair stable trousers, 2 pairs drawers, 1 cloak, 1 pair gloves, 1 pair boots, 1 pair short boots, 1 pair half-soles, 2 shirts.

Equipment.—1 helmet (or other head-dress), 1 cuirass (for cuirassiers only), 1 pair wallets, 1 sword-belt, 1 sabretache and girdle (for hussars only), 1 sword-knot, 1 pair spurs, 1 cross-belt and cartridge pouch, 1 carbine bucket and strap, sling, box of spare parts, grease-box, and 2 cartridge-boxes for men armed with carbines, and a pistol case and straps for men armed with pistols. Lancers have a lance, pennon, and straps, with 2 lance-buckets, and all cavalry carry canteens and bags for rice, salt, and coffee.

Miscellaneous Articles.—1 bag of bandages, 1 mark of identity, and a bag of cleaning materials. Small coffee-mills are also carried in the proportion of eight or nine per squadron.

Tools.—In each squadron 34 hatchets are carried on the troop horses, and besides these 6 hatchets and 8 spades are conveyed in each squadron wagon. Every squadron has moreover the set of light tools for the destruction of railways which has been already mentioned. These are secured in seven cases which are fitted for pack transport.

Cavalry Pioneers.—In the Bavarian and Saxon cavalry peculiar attention appears to have been devoted to the equipment of cavalry pioneers, four to six men per squadron being allotted to this duty and supplied with tools both for destruction and repair. These pioneers are armed only with sabre and pistol. In the rest of the German Army whatever steps may have been taken in this direction are kept secret.

Regimental Distinctions.—Cuirassiers : the jacket (*Koller*) is of white kersey fastened with hooks and eyes, with facings of a distinctive colour[2] the shoulder-straps being white, with an edging of the regimental colour, and bearing the number or distinguishing cipher of the regiment. Pantaloons of white kersey are worn with high boots reaching above the knee, but grey cloth trousers and linen stable trousers are also worn. The cuirass is of white metal, and consists of breast-plate and back-piece, and weighs about 16 lbs. All cuirassiers wear metal helmets, those of the Guard and the 6th Regiment being of brass, and the rest of white metal. In the Guards, the helmet is surmounted by an eagle for parade occasions, but in other regiments by a spike.

Arms.—Cuirassiers are armed with a straight sword (*Pallasch*) 37 inches long, and weighing 3 lbs. without the scabbard. Twenty-five men in each squadron are armed with Mauser carbines, and the rest carry six-chambered revolvers.

Squadron Distinctions.—In all German cavalry regiments the squadrons may be distinguished in the same way as the companies of an infantry

[1] A Captain is allowed 55 lbs., and a subaltern 46 lbs.

[2] Full particulars as to these colours are given in "Deutschland's Streitkräfte," and in Colonel Rivière's work.

battalion, viz., by the colour of the sword-knot, which is white for the 1st squadron, red for the 2nd, yellow for the 3rd, light-blue for the 4th, and green for the 5th.

Lancers.—The Prussian Lancers wear a short tunic (*Uhlanka*) of dark-blue cloth with collar and cuffs of the regimental colour, and for parade lappels of the same colour are worn. Dark-blue pantaloons, strapped with leather are worn, with boots reaching to the knee. The head-dress is the ordinary lancer hat (*Czapka*) of black leather with brass chain and white plume.

Arms.—Lancers are armed with the lance, a light curved sabre, and a breech-loading carbine which is similar in construction to the infantry rifle and takes the same ammunition. The lance is 10 feet long, and weighs 4½ lbs. It has a four-edged tip 6 inches in length made of steel.

Dragoons.—In Germany dragoons wear a tunic of cornflower blue cloth, with collars and facings of the regimental colour, and a single row of buttons. Tight-fitting pantaloons of dark-blue are worn as in the lancers, the boots being of the same pattern. The infantry helmet is worn, with yellow or white mountings according to the colour of the buttons.

Arms.—Dragoons are armed with the same carbine as that adopted for the cavalry generally (model 1871), and with a cavalry sabre somewhat heavier than that used by the lancers.

Hussars.—The German hussars wear a short tunic (*Attila*) of various colours, red, black, brown, green, blue, &c., with five rows of worsted lace across the breast. The pantaloons are like those of the dragoons, with a narrow stripe of the same colour as the lace on the tunic. They are worn with a boot which reaches only to the middle of the calf of the leg. The hussars' head-dress is a busby with a plume, and a bag of the same colour as the tunic. In the Guard Regiment, and in the 3rd, 12th, and 15th Regiments, a blue pelisse lined with fur is worn either as an overcoat or hung over the left shoulder.

Arms.—The armament of hussars is exactly the same as that of dragoons.

Saxon and Bavarian Uniforms.—In the different contingents of which the German Army is composed, several differences have been retained, as for instance in the Saxon Lancers, which have light-blue tunics and pantaloons, and the Bavarian Lancers, whose uniform is a gray-green. The Bavarian heavy cavalry wear light-blue tunics with dark-blue pantaloons and leather helmets, while the Bavarian light cavalry wear a green tunic and green pantaloons, their head-dress being a helmet similar to that of the Bavarian infantry.

Weights.—The weight of a cuirassier or uhlan in complete marching order, with one day's oats and one ration of bread, may be taken as 22 stone, while that of a hussar or dragoon is about 18 stone.

Artillery.—Field Artillery.—The principal difference between gunners and infantry soldiers in the German Army is that the gunner's helmet is surmounted by a ball instead of a spike, and that the shoulder-straps are always red, with the number of the brigade marked on them in yellow. Drivers have pantaloons strapped with leather and high boots like dragoons, and horse artillery men are dressed almost in the same way, but have hair plumes to their helmets.

Arms.—Gunners of field batteries are armed with the artillery fascine knife, but gunners of horse artillery batteries, non-commissioned officers, trumpeters, and drivers have a sabre similar to that used by the uhlans, and a revolver. Dismounted men of ammunition columns are armed with carbines, and sword bayonets.

Tools.—The entrenching tools carried with a battery, either of field or horse artillery, are 14 axes, 36 hatchets, 18 picks, and 29 spades.

Field Guns.—It has been mentioned already that the field battery and

horse artillery guns are known respectively as the 9-centimetre and 8-centimetre guns, and of these guns the following are the most important data :—

	8-cm.	9-cm.
Calibre	7·85 cm.	8·8 cm.
Length	82·68 inches.	82·68 inches.
Weight	7·67 cwt.	8·86 cwt.
Number of grooves	24	24
Twist in calibres	1 in 50	1 in 50.
Exterior diameter of gun at muzzle	5·12 inches.	5·51 inches.
" " " at breech	8·46 "	9·05 "

The breech mechanism is similar in both guns, being the system known as Krupp's cylindro-prismatic wedge.

The following are some of the details as to the ammunition used with the German field guns :—

	8-cm.	9-cm.
Charge	2 lbs. 12 oz.	3 lbs. 5 oz.
Weight of common shell (loaded)	11 " 3 "	15 " 7 "
Bursting charge	6 oz. 14 dr.	9 oz. 14 dr.
Weight of shrapnel (loaded)	12 lbs. 3 oz.	17 lbs. 15 oz.
Bursting charge	10¾ dr.	12¼ dr.
Number of balls	122	209
Effective range, common shell, 25° elevation	6,196 yards	6,551 yards.

The gun-carriages are made of steel, and the ammunition boxes of sheet iron. All the wheels are of similar construction, viz., of wood with metal naves, and of the same diameter (55·1 inches), so as to be interchangeable. The number of the regiment to which the battery belongs, the number of the battery, and the number of the gun are painted in white on each gun-carriage, and the other carriages of the battery are similarly marked. For example, the 5th gun of the 3rd Horse Artillery Battery of the 1st Regiment of Artillery of the Guard would be marked "1 G.A.R. 3.r. B. 5."

Pioneers.—There is practically no difference between the uniform of pioneers and that of infantry, except that the ornaments on the helmets of pioneers are always of white metal, and that they have only one pouch on the waist-belt instead of two.

Tools.—The tools carried by the men of a pioneer company are as follows: 18 hatchets, 44 pickaxes, 45 axes, and 88 large spades. In addition to these, however, 60 large spades, 30 pickaxes, 20 axes, 12 saws, and other tools are carried in the company tool wagon.

Telegraph detachments may be recognized by their wearing a T on the shoulder-strap, and railway troops by an E. The latter troops do not wear a helmet.

Arms.—Pioneers are armed with converted Chassepôt rifles, but have only 20 rounds of ammunition.

Train.—Train soldiers are equipped like infantry soldiers when attached to dismounted branches, and like cavalry when with mounted troops. Men of the train when permanently attached to other branches of the Service are dressed like the troops to which they are attached, but wear a forage cap with a peak, instead of a helmet.

The ordinary tunic of a train soldier is of dark-blue cloth with light-blue collar and cuffs, and when on duty with a train battalion he wears a shako and is armed with a converted Chassepôt rifle. Officers belonging to the train do not wear the shako, but have a helmet like that of infantry Officers.

XI.—Officers.

The efficiency of the German Army is so closely connected with the system under which its Officers are appointed and trained, that even a brief sketch like the present would not be complete without some reference to this subject. The principle which is adopted, and which is most strictly followed, is that no post in the Army shall be held by anyone who is not *thoroughly* competent to perform its duties, every consideration being made to give way to what is really for the good of the Service. In accordance with this principle it is recognized that Officers should in all cases be of good social position, in order to maintain their authority over their men, and thus promotion from the ranks is practically unknown. As a general rule, a young man who wishes to become an Officer must first serve with the regiment as a Portepée Fähnrich, a position which he may attain in one or other of two ways. He may have become a cadet, and on completing the course of instruction laid down, be appointed to a regiment as a Portepée Fähnrich, or in a few cases of exceptional merit as a Lieutenant, or else he may, if between the ages of 17 and 23, enter the Army with the expressed intention of becoming an Officer in the regiment whose ranks he joins. A young man cannot, however, join a regiment under these conditions without the consent of its Colonel, and this consent is absolutely refused to any candidate whose character will not bear the severest scrutiny, and who does not appear in every respect suitable for admission as an Officer. A test examination must be passed, and the "avantageur," as he is styled, must also show that he has sufficient private means to enable him to live like a gentleman, besides proving his claim to gentle birth. When all these conditions are complied with, the avantageur joins the regiment as a private soldier, being required to perform all duties, other than those of a menial nature, exactly as other recruits, but as a rule being allowed a separate room in barracks, or one shared with another avantageur. He is, however, from the first accepted as an associate by the Officers of the regiment, and is allowed to dine at mess, where his behaviour is naturally a matter of careful scrutiny.

After some five months' service, having by this time thoroughly learnt his duties and been dismissed drill, he is given the rank of non-commissioned officer on the recommendation of his Captain, and after about ten months' service is sent to the War School[1] with the rank of Fähnrich, being there instructed in tactics, fortification, and other military subjects. At the end of his course he rejoins his regiment and serves as a Fähnrich, but now wearing an Officer's sword and doing Officer's duty, until a vacancy occurs among the Lieutenants. His name is then submitted at a meeting of all the Officers of the regiment, who have to give their votes individually for or against his admission as their comrade. If all are unanimously in his favour he is at once recommended for a commission, but if he has only a majority of the votes, those who are opposed to his admission are called on to state their objections in writing, and a summary of these opinions is laid before the Commander of the Army Corps, by whom the question is finally decided. If the majority are against the candidate, and consider him unfit to become an Officer, he is at once rejected, and can never hope to obtain a reversal of this decision.

When a young man has once become an Officer his promotion generally goes forward by seniority, always supposing that he has proved himself fit for the duties of a higher rank. His fitness in this respect is, however, not ascertained by examination as we understand that term, but by the manner in which he has executed a number of military problems submitted to him in the course of his service, as well as by the manner in which his ordinary duties

[1] There are in all nine of these schools, established at Potsdam, Metz, Anclam, Neisse, Engers, Glogau, Hanover, Cassel, and Munich.

are performed. As high military training is not a matter of recent introduction in the German Service, it follows that the superior Officers are thoroughly conversant with every detail of their subordinates' duties, and perfectly capable of judging of their fitness for promotion, so that if an Officer is considered unsuited for a rank higher than that which he holds, he will be remorselessly passed over, and no amount of interest or favouritism will enable him to reach a position in which he might, by his ignorance or inefficiency, cause or conduce to a military disaster.

Those Officers who have peculiar ability and ambition seek to belong to the General Staff, by which they obtain more rapid promotion than falls to the lot of the regimental Officer, and through which alone they can hope to reach the highest posts in the Army. Any subaltern Officer of more than three years' service may present himself for admission to the Krieg's Akademie, and from those who present themselves 100 are annually selected. This selection is made partly on the basis of the results of an examination which all must pass, but to a greater extent on the personal report of the candidate made by the Officers under whom he has been serving. After three years spent at the Krieg's Akademie the Officers are sent back to their regiments, there being no final examination at the end of the course of study, and are afterwards chosen for duty with the Headquarters Staff in accordance with the reports which have been received of their ability and industry during the time passed at the college. In the year and a half which these selected Officers spend at Headquarters they are under the eye of Field-Marshal von Moltke, and those of them who are recommended by him are transferred to the Staff Corps and promoted to the rank of Captain, by which step the Staff Officer usually gains about one year's seniority over the regimental Officer. After about two or two and a half years' duty on the Staff, the Captain is sent to command a company, squadron, or battery, according to his arm of the Service, for about two years, and if he continues to show a constant zeal and interest in his profession he is then promoted to the rank of Major, and thus gains a total advantage of from five to six years' seniority. In every rank the Staff Officer does duty both on the Staff and with a regiment of his original arm of the Service, but not among his old comrades whom he has superseded, and if at any time it appears that his physical powers are failing, or that he is less zealous or less devoted to his duties than he formerly was, his military career is practically at an end.

Officers who have not passed through the Krieg's Akademie are also selected on the recommendation of their Commanding Officers, and their merits are tested by certain military problems sent to them by Field-Marshal von Moltke. If these are dealt with satisfactorily, the Officers are attached to the Great General Staff and further tested in the same way as those who have successfully passed through the Krieg's Akademie, when, if their work meets with approval, they obtain the same reward, namely, admission to the Staff Corps.

Promotion in the German Army in peace-time is slow, especially in the lower ranks, the average time spent as a subaltern being 12 years, and as a Captain from 6 to 8, so that the advantages held out to those who prove themselves worthy of Staff employ are very substantial, but to reap the full benefit of these advantages the Officer must never relax his diligence, but must always prove himself the superior of the highly educated regimental Officers over whom he is placed in the intervals of his Staff service.

In considering this German system of advancement by merit not determined by the hard and fast rules of the percentage of marks gained at an examination, one cannot help being struck by the evident absence of any fear that the selection of individuals might be attributed to jobbery. The efficiency of the Army is so keenly felt by every German to be a matter of life and death to the

nation, that the idea that any possible consideration should interfere with securing the services of the very best man for each post seems never to enter the mind of any critic, whether civil or military.

XII.—Military Discipline.

Habits of discipline are well understood by every German before he joins the Army, having been learnt by home teaching as well as by the training to which he is subjected in the Government schools throughout the country, and consequently the recruit adapts himself naturally to barrack life. But with such a high standard of intelligence and education as the average German recruit brings with him, it is more necessary to guard against his cavilling at the orders which he may receive, than to provide for direct disobedience of those orders; and this is secured by the personal influence of the Officers quite as much as by the infliction of punishment.

Officers, however, are armed with considerable powers; the punishments which they can award being as follows:—

For non-commissioned officers: reprimand, with various degrees of publicity; extra duty; confinement to barracks up to four weeks, or in lock-up to three weeks.

For lance-corporals and privates: extra duties, or attendance at roll call in specified dress; deprivation of control over pay for a limited time; obligation to return to barracks at an earlier hour than tattoo for the space of four weeks; arrest in barracks (open arrest) up to four weeks; arrest in lock-up (medium arrest) up to three weeks; arrest in cells (close arrest) up to fourteen days.

The extent to which Officers can award summary punishment varies with their rank. Thus, while the commander of a regiment can give the heaviest punishments above mentioned, the commander of a battalion can only give up to 14 days' arrest in barracks for non-commissioned officers and privates, up to 10 days' arrest in lock-up, and up to 7 days' in cells, for privates only. In the same way the company commander cannot give more than 8 days' arrest in barracks to non-commissioned officers and privates, and 5 days' arrest in lock-up, or 3 in cells, to the privates under his command.

Officers are liable to be punished either by reprimand, or by arrest in quarters up to 14 days, but arrest for this period can only be awarded by the General commanding the Army Corps. A Divisional commander can sentence an Officer to 10 days' arrest, and a regimental commander may give 6 days, but if a battalion commander finds it necessary to place an Officer in arrest he must report at once to the regimental commander, by whom the ration of the arrest is determined.

Where the offence is too serious to be dealt with summarily, the case is submitted either to a regimental or to a general court-martial, after having been first investigated by a court of inquiry. The regimental court-martial has the following composition: a Captain is President, the members being two First Lieutenants, two Second Lieutenants, two non-commissioned officers, and two privates; these latter being replaced by two non-commissioned officers where the prisoner is a non-commissioned officer. The other nature of court-martial is called a general or garrison court, and consists of five ranks of members, of whom the President is one, with a Deputy Judge Advocate or investigating Officer as assessor. The composition of the court varies according to the rank of the prisoner, as shown by the following table:—

Rank of accused.	Field-Marshals.	Generals of infantry.	Lieut.-Generals.	Major-Generals.	Colonels.	Lieut.-Colonels.	Majors.	Captains.	1st Lieutenants.	2nd Lieutenants.	Sergeants.	Non-commissioned officers.	Privates.
Private	..	..	..	..	..	..	P	2	2		3		3
Non-commissioned officer	..	..	..	..	..	..	P	2	2		3	3	—
Lieutenant	..	..	..	..	..	P	2	2	2	2	—	—	—
Captain	..	..	..	..	P	2	2	2	2	—	—	—	—
Major or Lieut.-Colonel	..	..	..	P	2	2	2	2	—	—	—	—	—
Colonel	..	..	P	2	3	2	2	—	—	—	—	—	—
Major-General	..	..	3	3	3	and a General of superior rank as President.							
Lieut.-General	..	3	3	3	..								
Field-Marshal	3	3	3	..	..								

When the offence with which the prisoner is charged is grave, and entails capital punishment or imprisonment for life, there are three members of each rank in addition to the President.

The punishments to which a German soldier is liable are death, confinement (*i.e.*, imprisonment, detention in a fortress, or arrest), and, when the offence is of a dishonourable nature, dismissal from the Service with incapacity to serve again in the Army or the Navy. A sentence of arrest is given when the period of confinement does not exceed six weeks, but one of detention in a fortress or imprisonment may be for life. The maximum period of close arrest is not to exceed four weeks, during which time the prisoner is in solitary confinement in the dark with a hard board for a bed, and bread and water as food, except every third or fourth day, when he is given his usual bed and diet.

When on active service and means are not at hand for carrying out sentences of confinement, offenders are instead tied up to a post for a certain number of hours during the day, or left fastened all night in a similar manner.

Courts of Honour.—Differences between Officers are referred to tribunals known as courts of honour, whose duty it is also to guard the honour of the cloth by taking proceedings against any Officer whose conduct appears to be unworthy of the position he holds. These courts are of two kinds: one, for the trial of Captains and subalterns, formed of all the brother Officers of the accused under the presidency of the Colonel, and one for the trial of a Field Officer, composed exclusively of Field Officers of the Army Corps, under the presidency of a General specially detailed.

Councils of Honour.—From the members of each court of honour a sort of standing committee called a council of honour is annually elected. This council, which for a regiment consists of a Captain and First Lieutenant and Second Lieutenant, and for an Army Corps of a Colonel, a Lieutenant-Colonel, and a Major, has the duty of calling attention to the conduct of any Officer whom they consider to have acted in an unbecoming manner, and on being so ordered by the Commanding Officer, may make a preliminary inquiry into the circumstances of the case. When this inquiry is completed the council lay their report, together with the defence of the accused Officer, before the court of honour, and this court then gives its judgment. Its verdict may be to the

effect that it is incompetent to try the case, or that the investigation should be more fully gone into, or it may either acquit the accused or recommend him for punishment. The punishments which a court of honour is competent to recommend are that the accused Officer should be reprimanded, that he should be allowed to retire from the Service, or that he should be dismissed from the corps of Officers. The recommendation of the court having been put into the form of a judgment by the council of honour, is sent with the proceedings to the Emperor for his decision. It is to be observed that the members of a court of honour are not sworn, and have no power to administer an oath to a witness, but in adjudicating on a case they are placed on their honour, and the Officers who appear before them as witnesses give their evidence under the same conditions.

In concluding this short outline of some of the most salient features of the German Army, it may be as well to note that as yet, in spite of the adoption of a Colonial policy by Germany, no provision appears to have been made for the despatch abroad of such small expeditions as those which we have so frequently been obliged to send to our Colonies. It remains to be seen whether, when the emergency arises, Germany will be more successful than France has been in overcoming the difficulties of combining such expeditions with a system of universal military service, but if we consider this highly organized German Army as it stands, merely with reference to its employment in Europe, the question inevitably presents itself, "Against whom will this powerful engine next be employed?"

That it will be against either France or Russia, or the forces of both these Powers combined, seems more than likely, but though in any case a far more severe struggle than that of 1870–71 may be anticipated, those who are best acquainted with the German Army and the German people have little doubt as to the result; and to us Englishmen it may well be a source of satisfaction that this paramount position as a military Power should be occupied by the nation to whom we are most closely allied by ties of policy, as well as by the bonds of race and religion.

REVIEWS.

Our South African Empire. By W. Greswell. London: Chapman and Hall, 1885. 2 vols. Pp. 640. Size 8″ × 5½″ × 2¾″. Weight 3 lbs. Price 21*s*.

Mr. Greswell gives us a history of South Africa from what he considers its commencement in 1652, when Van Riebeck landed in Table Bay, down to the present time. As he truly says, our South African Empire has grown up in spite of the protests of the mother country. It has never been clearly and definitely laid down whether an independent Dutch State or States should be allowed to exist alongside of our own Colonies or not. Consequently we hear of independence being given and then taken away. The Republics themselves have been at a loss to know what the real intentions of Englishmen have been in South Africa, their affairs being first at the mercy of a progressive and then of a retrogressive Cabinet in England. Mr. Greswell feels convinced that the country has a magnificent future before it, and this feeling probably colours his views, but at all events the effort to promote the interests of South Africa is a laudable one. Mr. Greswell says: "South Africa sighs for peace, and until peace spreads her ample wings over the land there can be no progress or civilization. The native is the subject over whom the wrangle of debate and the clash of battle is heard." The real difficulty seems to us to be that the native of South Africa, unlike the native in Australia, New Zealand, or America, does not appear to have the slightest intention of "dying out," and his persistent refusal to offer this simple solution of the real African question constitutes the difficulty, a difficulty still further increased as he is not to be made to work for the white man. Mr. Greswell's work is, however, a timely contribution to the consideration of the subject.

Turenne. By H. M. Hozier. London: Chapman and Hall, 1885. Pp. 198. Size 7¾″ × 5¼″ × ½″. Weight under 12 ozs. Price 4*s*.

The endeavour of Colonel Hozier is to give a connected story of the steady advance in life of this great commander, and to trace the various changes which he conducted in the science of war from the time that he was first made a Marshal until he fell mortally wounded. Not confining his efforts to mere biography, Colonel Hozier deals with the questions why early in the seventeenth century cavalry was a predominant force in European armies; why sieges were as a rule the principal operations of war; and with other important military questions. By the issue of this handy series of military biographies, Messrs. Chapman and Hall are supplying a real *hiatus* in the libraries of Officers.

Suakin, 1885. By Major E. Gambier Parry. Second Edition. London: Kegan Paul, 1886. Pp. 271. Size 6¾″ × 4½″ × ¾″. Weight 12 ozs. Price 5*s*. New edition, with author's name, 2*s*. 6*d*.

A pleasantly written and chatty sketch of the author's personal experiences.

From Korti to Khartoum. By Colonel Sir C. W. Wilson. London: Blackwood, 1885. Pp. 313. Size 7½″ × 5¼″ × 1¼″. Weight 1 lb. 5 ozs. Price 5*s*.

Well written and invaluable as a contribution to the "History of the Nile Expedition," inasmuch as the author occupied a prominent position in the events he narrates. The campaign with which Sir Charles deals is too recent for us to offer any criticism on the work before us.

The Coming Struggle for India. By Arminius Vambéry. London: Cassell, 1883. Pp. 208. Size 8″ × 5½″ × 1″. Weight 1 lb. 2 ozs. Price 5*s*.

The contributions by this well-known writer to the discussion of the important

question which he deals with are always valuable, and hardly require the excuse which he puts forward in the concluding chapter for his pertinacity in continuing his progress along the path of political writing.

Cromwell et Mazarin. Deux Campagnes de Turenne. Par Jules Bourelly. Paris: Perrin, 1886. Pp. 323. Size $7\frac{1}{2}'' \times 4\frac{3}{4}'' \times 1\frac{1}{4}''$. Weight 1 lb. 3 ozs. Price 4*s.*

This work, for the composition of which the author has made use of a number of letters hitherto unedited of Mazarin and Turenne, is a valuable contribution to the study of the military history of this period.

History of Burma. By Lieutenant-General Sir Arthur Phayre. London: Trübner, 1883. Pp. 304. Size $8\frac{1}{2}'' \times 6'' \times 1\frac{1}{4}''$. Weight 1 lb. 12 ozs. Price 14*s.*

This book is one of Trübner's Oriental Series, and will be found of great interest to those who, now that Burma is part of the Empire, have their attention turned in this direction.

Martial Law and the Custom of War. By Lieutenant-Colonel Tovey, R.E. London: Chapman and Hall, 1886. Pp. 168. Size $7\frac{1}{4}'' \times 5'' \times 1\frac{1}{4}''$. Weight $1\frac{1}{4}$ lbs. Price 4*s.*

Even the dry subject of Martial Law can apparently be made interesting, and Officers would in view of the state of things at home do well to turn to this book and see how military men are situated in the event of social disturbances.

The Parliamentary Generals of the Great Civil War. By Major Walford, R.A. London: Chapman and Hall, 1886. Pp. 268. Size $7\frac{3}{4}'' \times 5\frac{3}{4}'' \times 1''$. Weight 14 ozs. Price 4*s.*

In a few pages the author brings before us the principal events of the history of this war. We own, however, a feeling of regret that Major Walford, so thoroughly able as he is to unravel the entangled threads of campaigns, has been restricted in the space at his disposal. The account of the armament and the tactics of this period given in the introduction are most interesting, and we should have been glad if the strategy of the war had been explained at greater length.

Cavalry Instructions. Course of Lectures. By Captain Baden-Powell, Adjutant 13th Hussars. London: Harrison, 1885. Pp. 213. Size $4\frac{1}{2}'' \times 5\frac{1}{4}'' \times 1\frac{1}{2}''$. Weight 5 ozs. Price 3*s.* 5*d.*

This little book shows in the fullest detail one method of carrying into practice the one month's Squadron Instruction prescribed by G. O. 30, 1884. No one method can be rigidly applied everywhere; each place necessitates modifications; and the more the various methods adopted in different regiments or in different garrisons brought before the military public, the greater chance there is for a squadron leader to evolve from them the method most suited to his own requirements. A second edition has just been published.

Remarks and Suggestions on our Military System. By Captain Purdon, North Staffordshire Regiment. Chatham: Gale and Polden. Pp. 63. Size $5'' \times 7\frac{1}{4}'' \times \frac{1}{4}''$. Price 2*s.*, post free.

Captain Purdon offers some suggestions with a view to promoting the smooth working of general efficiency of our military system, and to rendering its organization more handy in time of need.

Précis de la Campagne de 1805 *en Allemagne et en Italie.* Brussels: Marquardt, 1886. Pp. 267. Size $5'' \times 6\frac{3}{4}'' \times 1''$. Weight under 1 lb. Price 4*s.* 6*d.*

This volume is the first of a projected series of works on military history, entitled "Bibliothèque Internationale d'Histoire Militaire," which is to be completed in twenty-five volumes, the last of which will treat of the operations of 1828–29 and 1877–78 between Russia and Turkey. The whole series covers European wars from 1630 to the present time.

excuse
tinuing

Paris :
ice 4s.

nber of
tion to

ondon :
ice 14s.

interest
rned in

, R.E.
t 1¼ lbs.

ng, and
is book

d, R.A.
Weight

story of
roughly
cted in
of this
en glad

djutant
Weight

practice
No one
cations ;
ifferent
for a
is own

, North
″ × ¼″.

smooth
ganiza-

quardt,
.

entitled
eted in
828–29
an wars